The FOUNDRY

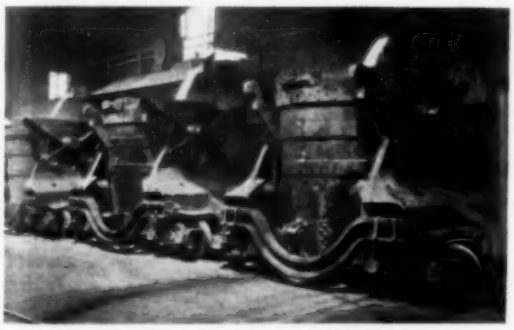
Volume 58
Number 24

Published
Semimonthly

CLEVELAND, OHIO, DECEMBER 15, 1930

Castings Carry Molten Metal from Blast Furnaces

LADLES are used to carry molten iron and steel when transported interdepartmentally at the blast furnace or the steel mill. The first step in the manufacture of ferrous metals is the mining of the iron ore, and the next operation is



Castings Support Large Ladles for the Transportation of Molten Iron

the reclamation of the iron from the ore in the blast furnace. When the molten metal is tapped from the blast furnace, it either is received by ladles for transportation to the mixers or is allowed to run into pig beds formed in sand close to the furnace. A second method of pig iron manufacture, namely, the machine casting method, involves transportation. Ladles also are used to carry molten metal from the mixer to the open-hearth furnace or converter and from there to the ingot molds into which it is teemed. Castings are used extensively in the construction of ladles. Two large castings, mounted at the ends of each car, support the ladle on trunnions. Two other castings, one on either side of the ladle integral with the main carrying and supporting trunnions, are part of the tripping mechanism when the molten iron is cast on the pig casting machines. Side frames, draw bars, and wheels are other castings that make possible the transportation of molten iron.

Find Where Castings Can Be Sold

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PUBLISHED BY THE PENTON PUBLISHING CO.,
Penton Building, Cleveland, O.

BRANCH OFFICES

CHICAGO.....1347 Peoples Gas Bldg.
CINCINNATI.....209 Edwards Bldg.
NEW YORK.....2203-2206 No. 220 Broadway
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PARIS, FRANCE.....No. 9 Rue de Londres
BERLIN, GERMANY.....Dahlmerstrasse 64A, Berlin Lichterfeld-West

Cable address, IROTRAPEN, London

SUBSCRIPTION

United States and Mexico.....$3.00 a year
Canada .....$4.00 a year
Great Britain and other Foreign Countries.....£1:0:0 a year
Single copies.....25 cents

Copies published three months or more previous to date of current issue, 50 cents each.

Member, Audit Bureau of Circulations, Associated Business Papers Inc., National Publishers' Association

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Reduces Production Costs with a New Steel Foundry

ERECTION recently by the Lebanon Steel Foundry, Lebanon, Pa., of a foundry and its equipment and operation on ultra modern lines, are in keeping with a definite policy consistently adhered to since the establishment of the company in 1912. This policy is based on the conviction that a manufacturer's existence, his success and prosperity, are in direct ratio to his ability to meet his customers' requirements, at a price that will yield a reasonable profit.

A brief resume of the history of the Lebanon Steel Foundry, indicates that its success, to a great extent is due to a constant improvement in method, equipment and processes. A readiness to discard the old and adopt the new, when the adoption showed promise of improvement in product of economy in operation. An aggressive and intelligently directed sales policy, also has been an important factor.

From its inception in 1912 to operate a small crucible steel casting plant the company has specialized in the production of small and medium weight castings of high quality. The company was one of the first in the United States to adopt the electric furnace as a melting medium in the steel foundry. A 1-ton furnace was installed in 1915. A short time af-

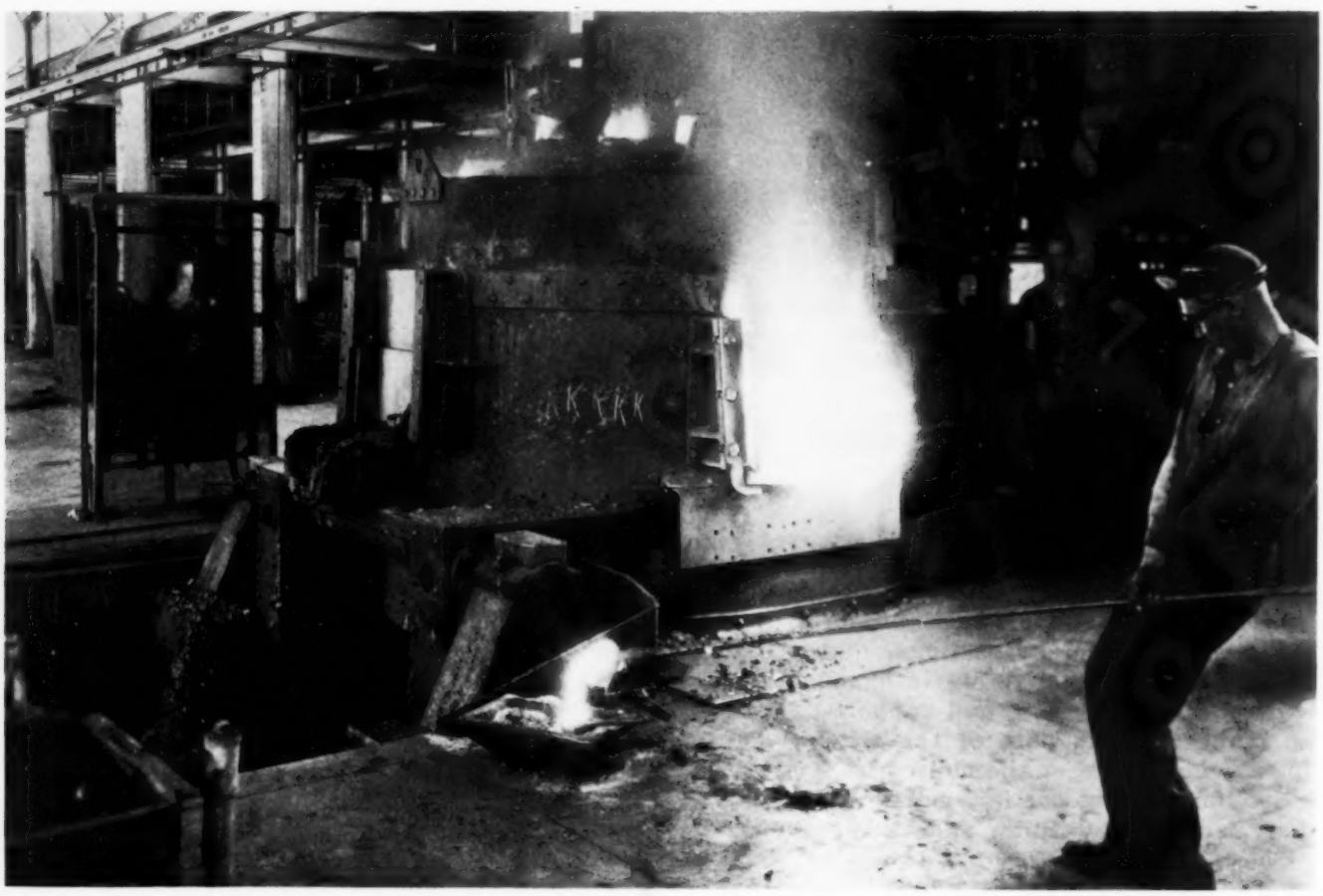

Fig. 1—The Skilled Melter Can Form a Shrewd Approximation of the Fluidity, Temperature and Composition of the Metal by Pouring a Test Block and Breaking It

Fig. 2—The 5000-Pound Charge Is Tapped Into a Single Ladle Suspended from the Crane

terward this was discarded to make room for a 2½-ton Heroult furnace and this furnace was supplemented later by an additional furnace of the same make and capacity.

These two furnaces constitute the melting equipment in the new foundry where they were moved from their former location in the old foundry. During the moving period, to be described later, they were practically rebuilt. Their places in the old foundry have been taken by two 1000-pound induction furnaces and one small experimental furnace of the same type made by the Ajax Electrothermic Corp., Trenton, N. J. Electrical equipment was supplied by the General Electric Co. These furnaces are devoted exclusively to the production of special alloy steels. The Lebanon Steel Foundry, in 1920 took an active part in the formation of the Electric Steel Founders' Research group, including the two present Sivyer Steel Castings companies, one in Milwaukee and the other in Chicago, the Michigan Steel Castings Co., Detroit, the Fort Pitt Steel Castings Co., McKeesport, Pa., and the Lebanon Steel Foundry, Lebanon, Pa. The work and accomplishments of this group have been discussed in previous issues of THE FOUNDRY.

Result of improved practice, constant research and intensive application is reflected in the successful production of high pressure fittings and many other types of steel castings regarded as late as 10 years ago as being outside the range of practical accomplishment. High tensile strength, reduced weight, resistance to shock, impact, torque and corrosion, appreciably have widened the field for the application of steel castings. After a careful survey of existing plant and conditions about a year ago the executive officers of the Lebanon Steel Foundry, decided that the old melting-molding shop with its many extensions had outlived its period of usefulness. From the standpoint of quality the castings were up to the highest standard, but from the standpoint of operating only a new building could make possible desirable improvements.

Having arrived at the broad general decision that a new foundry building was required modernly equipped in every respect and operated on the broad background of knowledge gained through accumulated experience of many years, the company began with characteristic energy to convert the plant into a tangible reality. The general plan was submitted to E. S. Carman, Inc., Cleveland, who worked out the engineering and architectural details. Briefly it may be said that the new shop is thoroughly mechanized and as a result it is claimed that the maximum production of 500 tons per month now is achieved on a single shift molding schedule instead of the double shift formerly in vogue. Under the new set-up

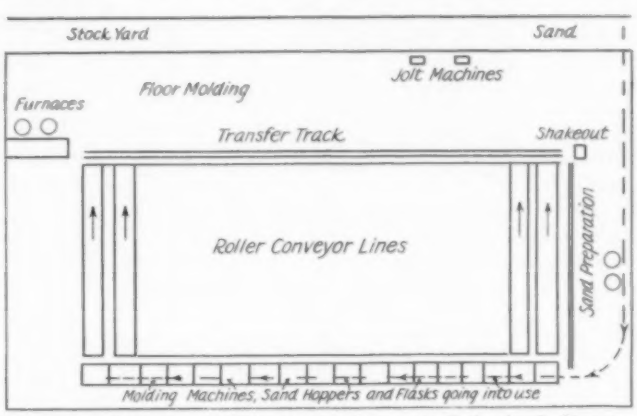

Fig. 3—Layout Showing Location of Principal Items

Fig. 4—Molding Machines Are Located in a Straight Row Under the Hoppers Containing the Sand

the output per man has been increased approximately 20 per cent.

Extreme neatness and cleanliness, always a favorite hobby with the management, is more in evidence than ever in the new foundry where white paint, aluminum paint and great expanse of windows effectually prevent the accumulation of dirt and debris.

While heating a foundry with hot air in winter is not an unusual practice, the method adopted in this new foundry is different from that ordinarily employed. The heating plant was installed by the Dravo-Doyle Co., Pittsburgh, and in its general features may be compared to a water tube boiler. The flame from an oil burner plays among rows of horizontal tubes in an enclosed brick chamber.

Air Heated in Tubes

Fresh air in sufficient volume is driven through these tubes and in a highly heated condition is discharged into a series of four main ducts extending longitudinally and parallel about 50 feet apart under the foundry floor. A natural law causes the air to rise through ducts and incidentally aids in the ventilation of the building. The ducts are steel and were cast in the old foundry.

The task of moving from the old shop to the new was carried out without any interruption in the operating schedule. One furnace was moved first and set up and then the various molding units were placed in operation one at a time. By the time the entire plant was in operation under the new system, all the bugs were ironed out and the entire plant was running with clock like regularity.

Layout of the foundry and approximate position of the various units are shown in Fig. 3, a free hand sketch, not drawn to scale. The two 2½-ton heroult furnaces are located near one end of a high bay served by two 7½-ton cranes made by the Shepard Crane & Hoist Co., Montour Falls, N. Y. The sand preparation and shakeout apparatus occupies the entire opposite end of the building. A battery of 18 molding machines, served by individual sand hoppers, extends along the south side of the building from

Fig. 5—Small Molds Are Loaded on Boards To Span Two Narrow Conveyor Lines

which it is separated by a wide gangway and short conveyor storage lines for empty flasks. Long roller conveyors extend north from the molding machines to a line of columns separating the miscellaneous jobbing bay from the machine section. The molds roll down steadily from the machines and accumulate at the far end of the conveyor lines where they are poured in batches each time the furnaces are tapped into 5000-pound teapot type ladles.

One of the traveling cranes carries the ladle from the furnace and with the aid of a double hook transfers it to the hook of a jib crane. The jib crane holds it suspended while the metal is distributed by a special pouring gang. An idea of the fluidity of the metal may be gained from the statement that as many as 300 small molds have been poured from small ladles filled from the crane ladle. Bottom pour ladles are employed when necessary. With the exception of special heats made for a wide variety of purposes, high carbon, low carbon, and alloy steels, the regular product of the foundry is plain carbon steel castings of which the following is a typical analysis: Carbon 0.25 to 0.35 per cent; manganese 0.70 to 0.80 per cent; silicon 0.35 to 0.45 per cent; phosphorus and sulphur under 0.05 per cent.

Representative physical properties of this steel when air quenched and drawn will show: Tensile strength 70,000 to 80,000 pounds per square inch; elastic limit 40,000 to 50,000 pounds; elongation 22 to 30 per cent and reduction in area 30 to 50 per cent.

Hand Shanks Are Used

Metal for the snap flask molds is hand shanked. Larger molds are poured from ladles supplied by the Modern Equipment Co., Port Washington, Wis., and equipped with easily controlled hoisting and tipping gear. The ladles are suspended from a monorail system installed by the American Monorail Co., Cleveland and equipped with air hoists made by the Ingersoll-Rand Co., New York. These hoists operate over each conveyor line. On the lines where the large

Fig. 6—Molds Are Dumped from the Conveyor on to a Jolting Shakeout Device

molds are made, these hoists also are employed in handling the flasks and in closing the molds.

The roller conveyor lines were supplied by the Eastern Corp., New York, and the rollers were made in various widths to accommodate the size of the molds. At the suggestion of the foundry executives the bearings were increased in size over the regular standard and the ball bearings were increased to a corresponding size. Dust exclusion ends, also designed by the foundry staff, were incorporated in the construction.

In this connection it is interesting to note that the foundry cast a set of track wheels for all the cranes, wheels made from a strong, wear resisting alloy steel and had them incorporated in the construction. Just another instance of the faith and pride the Lebanon foundry has in its own product.

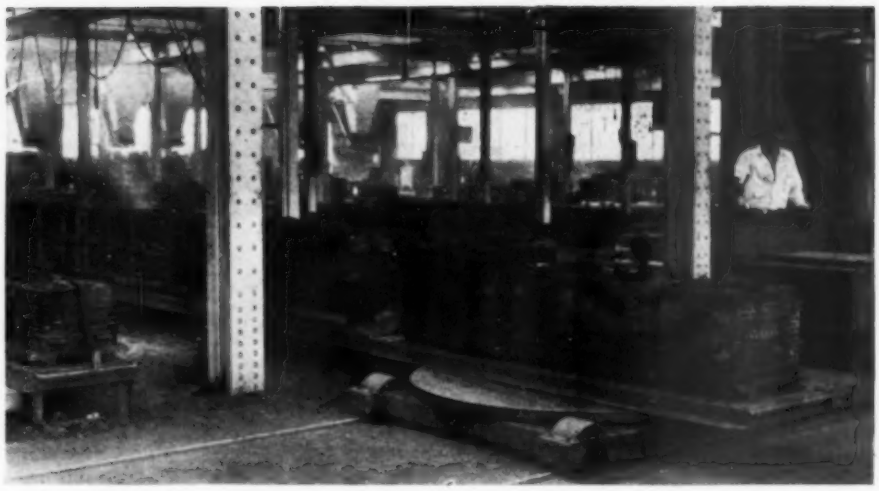

Fig. 9—The Load on the Transfer Car May Be Rotated To Coincide with Either the Molding or Shakeout Conveyor Lines

Prepare the Sand

An electrically operated transfer car brings the poured molds from the various conveyor lines to the shakeout station. The principal feature on this car, made by the Link-Belt Co., Chicago, is a roller conveyor section mounted on a turn table. With the machine spotted in front of the mold conveyor line, the turntable is swung into position and the molds are pushed on to it. The turntable then is swung through an arc of 90 degrees and the car operator drives the load of molds to the shakeout station.

While still moving at a fairly rapid speed, the end of the car cames into a violent contact with a bumper on the track. The sudden stop automatically unloads the car. The molds roll over the end on to a stationary section of roller conveyor and thence to a shakeout grating in the floor made by the Osborn Mfg. Co., Cleveland.

The small molds are dumped on the grating by hand and the larger molds are handled by a jib crane equipped with an air hoist. Snap flask molds are dumped at the point where they are poured. They are lifted by the bottom boards and the sand and castings are dumped into a steel bucket. The boards, weights and jackets are returned to place and

Fig. 8—Men Pouring Metal Wear Goggles and Leggings

the loaded bucket is conveyed either by crane or transfer car to the shakeout station where sand and castings are separated.

With the exception of a few molds that are skin dried, the molds are formed in green sand and for that reason the backing sand receives the same care and attention as the facing sand. After each batch of molds is poured and shaken out, the entire volume of sand involved is put through the sand preparation apparatus and carefully checked for bond, permeability and moisture content and adjustments made where necessary.

Pan Mullers Used

The sand preparation unit includes two motor driven pan type mullers formerly used in the old foundry, also a 200-ton storage hopper and auxiliary equipment designed by the Chain Belt Co., Milwaukee. The cone shaped bottom of the hopper was built to an angle of 55 degrees. Experience during the period the new sand system has been in service, since June of the present year, indicates that this angle is eminently satisfactory. The sand feeds through freely.

Method of conveying the sand from the shakeout and the various steps in its preparation conform to fairly well standardized routine and have been described in detail in THE FOUNDRY on many occasions. A pan conveyor under the shakeout discharges on to an inclined belt running over a magnetic separator made by the Dings Magnetic Separator Co., Milwaukee. The metal-free sand is carried aloft by a bucket elevator and discharged into a revolving screen and thence out to a large horizontal circular plate over the top of the storage hopper. Slowly revolving arms gradually work the sand toward the perimeter of the plate where it falls into the hopper in an aerated and cooled condition. Lumps and other refuse caught by the revolving screen, are discharged through a pipe terminating in a hopper on the outside of the building. A dust arrester removes the dust and fines from the system and also discharges into this hopper. At periodical intervals the

(*Concluded on Page* 59)

Fig. 7—The Backing Sand Is Reconditioned Continually in a Mechanical Plant

Preventing Unsoundness *in* Bronzes and Red Brass

Part V

ALTHOUGH porosity readily is identified as such, opinion varies considerably as to the immediate causes. While the effects have been modified in various ways as previously explained, the actual causes must be removed before the condition can be eliminated.

Recently Daniels, *Foundry Trade Journal*, April 3, 1930, has approached the problem of the causes of porosity. He says, "In the present work an attempt has been made to solve the problem in two ways: (1) By applying existing knowledge to the melting and casting of the alloy, and (2) by examining the effect of various gases on small quantities of the alloy melted in small carbon or fireclay boats in a closed tube.

Temperature Affects Soundness

"Carpenter and Elam confirmed the conclusion of Karr and Rawdon, that gunmetal cast above or below a certain range of temperature, 2050 to 2320 degrees Fahr. will be unsound. They also found that however much the metal may have been overheated, if cooled and cast at a temperature within the safety range, it will be sound.

"The effect of rate of solidification on the soundness of bronze has been studied by Sir John Dewrance, *Bronze Founding*, May 11, 1927, who has made a large number of highly instructive experiments. He indicates the dependence of the correct casting temperature on the type of casting being made, and emphasizes the importance of temperature control to minimize the effects of the gas present in the molten metal. He is in agreement with the views of Genders that control of the gas evolution during solidification will reduce the extent of inverse segregation.

"All these observers find that sound metal contains much hydrogen with little carbon monoxide and carbon dioxide, whereas unsound metal contains important proportions of the oxides of carbon. Both Sieverts, *Berichte, Deutscher Chemiker Gesellschaft*, and Iwase, *Science Reports*, Tohoko Imperial university, 1926, find that the addition of tin to copper lowers its capacity for dissolving hydrogen, and it has already been seen that several observers have extracted oxides of carbon from gun-metal. The experiments of Rontgen and Schwietzke indicate that sulphur dioxide has no detrimental influence on bronze and may even lead to an increase in strength.

"It is improbable that the increased soundness obtained by melting under strongly oxidizing conditions is due to the removal of the soluble gases by direct oxidation. For studying the influence of pure gases on bronze the metal was melted in a fireclay *combustion* boat and cooled at any desired rate, after gas treatment, either by adjustment of the current in the heating element or by moving the silica tube relative to the heating element.

"To study the problem, two lines of attack were used: (1) Melting and solidifying 50 gram charges in a stream of gas, using the apparatus mentioned. (2) Melting 10-pound charges in a coke furnace with varying conditions of fire. From these results it appears that both nitrogen and carbon dioxide act as neutral gases with respect to admiralty gunmetal, and that, after all the soluble gases have been swept out, the metal solidified quite sound, even after it had been treated with carbon dioxide for 100 minutes, thus indicating little, if any, chemical action between the molten bronze and the carbon dioxide.

"When the metal is saturated with hydrogen and allowed to cool in that gas the resulting ingot may or may not be sound. If the time taken to cool through the solidification range is 14 to 47 minutes (or probably even longer) the ingot is sound. If the time of solidification, however, is between 1.25 and 4 minutes, the ingot is quite unsound. If a correspondingly rapid rate of solidification is employed, in nitrogen or carbon dioxide, the ingots are perfectly sound.

Densities of Bronze Vary

"When carbon dioxide is passed through the furnace, the metal being contained in a graphite boat, 2100 degrees Fahr., the carbon dioxide and the carbon of the boat react to give relatively pure carbon monoxide. Ingots *O* and *AA* showed numerous oxide films on microexamination, but no blowholes. Further experiments with a 10 per cent copper-tin alloy in carbon boats, using carbon monoxide prepared by the action of sulphuric acid on formic acid, gave similar results, densities varying from 8.67 to 8.85 being obtained. Examination of the specimens showed that in no case were any blowholes present, but that, whenever the density was low, the metal contained numerous oxide films. It is concluded, therefore, that the low density was due to oxide and not to carbon monoxide, since when oxygen was absent the ingots were perfectly sound. In view of these facts it must be concluded that carbon monoxide acts as a neutral gas towards bronze.

"Allen found that carbon monoxide was a suitable inert gas for copper, and experiments have shown that it is also inert to bronze. He obtained a typically unsound casting of pure copper by treating cathode copper with carbon monoxide at 2100 degrees Fahr. for 1 hour and then casting (in the same atmosphere) into a warm steel mold, the copper entering the mold through a silica tube lined with copper oxide, which was picked up by the metal in its passage along the tube. If the tube were clean and no oxidation of the metal occurred, the casting was perfectly sound.

"In the experiments, designed to study the effect of varying furnace conditions on the soundness of cast

Causes of Porosity

WHILE considerable investigation has been devoted to unsound bronzes and red brass, most of the work has resulted in modifying the effects rather than ascertaining the actual causes. In this article, the efforts of Daniels to solve the problem of causes of unsoundness are described, with a discussion of his conclusions. Pouring practice and gating also are discussed in this article which is the concluding one of a series of five dealing with unsoundness in bronzes and red brass. The fourth appeared in the Nov. 15 issue.

bronze, 20 pound charges were melted in two distinct types of fire. First, a *reducing* fire in which the furnace hole was kept full of coke and the damper opened just enough to draw the products of combustion into the flue. Second, an *oxidizing* fire in which the fuel bed was kept as thin as possible and the damper maintained full open, so that there was some excess air passing through the fire. (Bamford and Ballard have found over 1 per cent of hydrogen in the furnace atmosphere 10 minutes after re-stoking).

Specific Gravity Determined

"To determine the unsoundness of the castings the specific gravity was determined by the method of Archimedes and corrected (reducing the figures 0.02 compared with previous ones) for temperatures of determination and then the percentage of voids calculated, using the following figures for the maximum density of the various alloys, perfectly sound:

Pure Copper	8.942
98 Copper-2 Zinc	8.92
90 Copper-10 Tin	8.90
88 Copper-10 Tin-2 Zinc	8.88

The first two of the above figures are due to Norbury, and the last two were obtained from the melts in carbon dioxide and nitrogen previously described. Table VII shows the results obtained for soundness and strength of the 88-10-2 alloy melted under the conditions indicated and cast in skin-dried green sand molds.

"These results indicate that the furnace conditions during melting of the alloy can be adjusted to give castings with a high degree of soundness or vice versa (*KJ*, density, 8.5; *KL2*, density, 8.77), and at the same time the *oxidizing* condition does not lead to low results in the tensile test (as *KF2*, 44,150 pounds per square inch and 28.5 per cent elongation). At the same time, better results were obtained by simple melting in an oxidizing atmosphere than by presolidification of the metal in a partially oxidizing atmosphere, although compared with simple melting in a partially oxidizing atmosphere, presolidification has resulted in increased soundness.

Table VII

Effect of Furnace Atmosphere

Mark	Density Gr./c.c.	Percentage unsound	Tensile Strength lbs./sq. inch.	Elongation % in 2 in.	Fire condition
KC2*	8.110	8.9	.....	.....	Reducing
KF2	8.751	1.45	44,150	28.5	Oxidizing
KJ1	8.507	4.20	34,380	20.0	Partially oxidizing
KJ2	8.501	4.27	36,620	20.0	Partially oxidizing
KK1	8.669	2.04	40,630	20.0	Partially oxidizing
KK2	8.739	1.62	13,980	13.0	Half previous charge presolidified
KL1	8.748	1.49	.....	.....	Oxidizing
KL2	8.771	1.23	.....	.....	Oxidizing

*Contains 90 copper and 10 tin.
Castings temperature of all specimens was 2100 degrees Fahr.

"But the assumptions made with regard to bronze fix the Cu_2O independently of variation in atmosphere. Let the quantity be represented by *X*. Then with the two atmospheric conditions under discussion, the quantity of hydrogen in equilibrium in the molten bronze will be *Y* for a *reducing* fire and *Z* for an *oxidizing* fire. In other words, there is more hydrogen to form water vapor in case *R* than in case *O*, and therefore an *oxidizing* fire will give less unsound metal than a *reducing* fire. At the same time there is possibly free hydrogen in the atmosphere of the reducing fire which would tend to increase this effect. It is possible than an explanation of the behavior of bronze on melting and casting in the foundry will be found along some such lines."

Daniel's conclusions are: "The observations of Karr and Rawdon, and Carpenter and Elam, with regard to the relationship between casting temperature and unsoundness of bronze have been confirmed. Variations in casting temperature affect the rate of solidification, other conditions remaining constant, and similar variations in rate of solidification obtained by constant-casting temperature into molds of different materials also affect the density of the casting in the same way.

"Nitrogen, carbon dioxide and carbon monoxide have been found to be neutral towards bronze. Hydrogen is capable of causing unsoundness in bronze at certain rates of solidification, and this unsoundness can be suppressed by treatment with neutral gases. It is possible that normally occurring unsoundness is due to the combined presence of hydrogen and oxygen in the molten bronze. It is different in character from that produced by hydrogen alone.

Rapid Melting Necessary

"Improvement in density of sand-casting can be obtained by melting in a pot-furnace with a thin fuel bed and good draught, compared with melting in a thick fuel bed and poor draught. This is not so with pure copper to anything like the same extent. Degasification with nitrogen, deoxidizers and presolidification gave negative results as far as improvement in density was concerned, but presolidification seems to increase the strength of the metal."

As is evident from the above quotations, the paper by Daniels is a masterly one, evincing thorough research and careful thought. It is destined for wide reference. Translated to practice Daniels indicates that a reducing atmosphere is most dangerous. One statement invites contradiction. While Daniels showed that carbon monoxide produced unsound metal in his laboratory experiments, he makes the amazing statement—"Whenever the density was low, the metal contained numerous oxide films." It is concluded that the low density was due to oxide and not carbon monoxide since when oxygen was

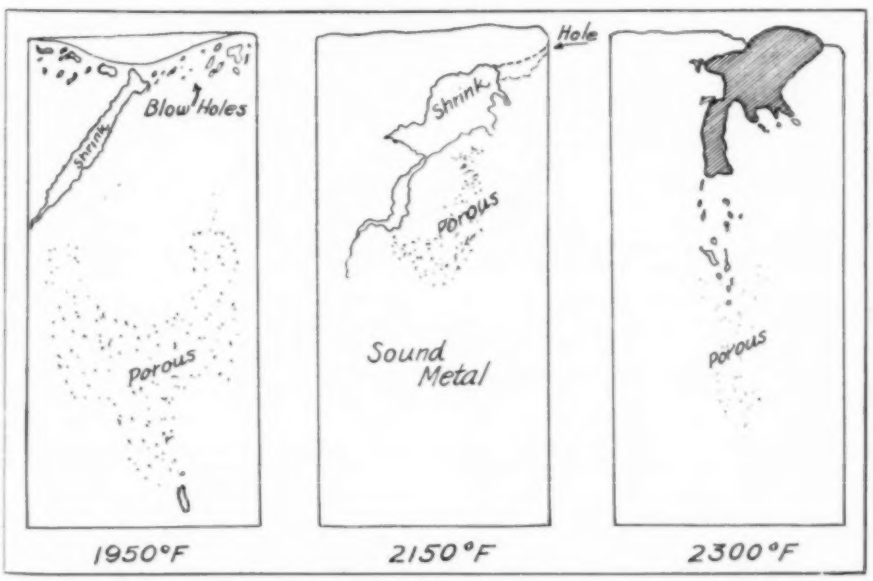

Fig. 26—Effect of Pouring Temperature under Reducing Atmosphere. Specimens Top-poured in Green Sand Molds Not Open to Air. Sketched from Deep-etched Sections

absent the ingots were perfectly sound. By what evidence are we to assume that these are *oxide films*? The table of experimental evidence indicates that with slow cooling the metal, solidifying slowly, can reject the absorbed gases. The low solubility of these gases as such, in the solid state is readily admitted. Thus we question his statement that carbon monoxide acts as a neutral gas toward bronze. The experiments of Allen are interesting, suggesting that metal charged with carbon monoxide may pick up oxide during pouring in air and that secondary reactions may produce carbon dioxide within the metal.

There has been a great deal of investigation and research on the pouring temperature range for various bronzes and red brasses. Most of this has been done on the 88-10-2 alloy, or gun metal. In spite of the volume of data available, it is advisable to avoid lengthy detailed and specific discussion of pouring temperature ranges. It is believed that such procedure is justified for several reasons.

First, it is obvious that the proper pouring range for a given alloy is not the same as that for another given alloy—and there are many alloys. Second, in a given alloy, different castings demand different pouring temperatures. Third, a great deal of work has been done to establish pouring temperatures to get rates of cooling at which effects of gas rejection would be minimized. That subordinates causes to effects. Do we want to know the ranges of temperature advisable for best results in gassed metal or do we want to know the ranges in which properly melted alloys will have the best casting and physical properties?

In a given alloy, free from excessive dissolved gas, the regulation of pouring temperature depends on the fluidity necesary for good pouring and feeding and on the grain structure desired. The higher the pouring temperature the greater the fluidity, the higher the volume contraction, the easier the feeding, and the greater the tendency of the metal to burn in and for rough surfaced castings. Good and bad effects both are manifest.

Let us assume that for a given casting the fluidity demands are not high, that the mold can be filled without cold shuts at a temperature only slightly above the liquidus. What then are the major effects of increasing the pouring temperature above this point? They are these (1) lowered cooling rate and (2) greater volume contraction.

When poured hot there is more heat to be dissipated during cooling to room temperature. The hot liquid metal heats the sand, the temperature gradients from casting to mold are lowered, the mold will not conduct heat away as rapidly. Naturally, the metal occupying the mold is hotter when pouring temperature is high. All this results in lowered cooling rate. This promotes large grain size and coarse columnar crystallization. In alloys of the type under consideration the pasty stage is prolonged. Segregations are more apparent.

If there is gas within the metal, it has more chance to escape and cause trouble within the casting. Since the skin of the mold has frozen, the gas either must be contained within the metal or be rejected through the gates and risers. Bolton and Weigand in *Transactions* of the American Institute of Mining and Metallurgical Engineers, 1929—show the effects of various pouring temperatures on an alloy melted under reducing atmosphere as depicted in Fig. 26. As has been pointed out by these workers when melting under neutral atmospheres pouring temperature range is widened, and for small castings greater fluidity and better feeding is gained by fairly high pouring temperatures. That in many small castings more than offsets the bad effects of somewhat coarser grain and slight dendritism. In heavier castings of course, high pouring temperatures should be avoided.

Second, hot pouring increases the gross contraction. The hotter the molten metal the greater the volume occupied by a given weight. Thus the mold when filled hot, contains metal of lower density, which contracts considerably before solidification starts. Then the change from liquid to solid involves another sharp and pronounced contraction. This is sometimes referred to as the liquid shrinkage. The latter occurs over a range of temperature for alloys, the so-called pasty range which has been described admirably by Dews on page 111 of the Sept. 1, 1930 issue of THE FOUNDRY.

Liquid shrinkage must be compensated by proper feeding. After solidification is complete the alloy contracts at a uniform rate down to room temperature, providing it is the solid solution type or a pure metal. However, as pointed out by Cowan in the *Journal* of the Institute of Metals (London), 1927, when eutectics (or compounds) separate after the bulk of metal is solidified, the possibly different contraction characteristics of such components, if greater than that of the remainder, may cause microscopic voids or fissures.

Table VIII

Effect of Additions to Copper

Composition				Sand Casting		Chill Casting		
Mark	Copper	Tin	Zinc	Density	% Unsound	Density	% Unsound	Fire Condition
KA1	100	....	....	6.810	23.8	8.465	5.3	Reducing
KC1	100	....	....	7.052	21.1	8.101	9.4	Reducing
KD1	100	....	....	6.939	22.4	8.192	8.4	Oxidizing
KF1	100	....	....	7.142	20.1	8.476	5.2	Oxidizing
KLA	100	....	....	7.318	18.1	.....	.....	Oxidizing
KA2	98	....	2	8.324	6.7	8.838	0.95	.....
KD2	98	....	2	8.238	7.1	8.784	1.5	.....
KC2	90	10	0	8.110	8.9	8.767	1.8	.....

Gating Fills Several Requirements

The objective of gating is to fill the mold perfectly and to supply fluid liquid metal to feed the casting and compensate for the liquid shrinkage. Some of the observations of R. R. Clarke, *Transactions* of the American Institute of Mining and Metallurgical Engineers, 1916, are as follows: "The smallest gate or set of gates conductive to casting quality, is the logical one in nonferrous work. A gate's capacity to perform its function varies with the degree of fluidity of the metal in pouring. The volume of all gates tributary to it should be reckoned from the volume of the delivery gate at its point of union with the casting. A good fillet will operate against a draw and will prevent the inbreaking of gates removed from hot castings.

"Sharp angles at turning points of gates are not conductive to best results. The top of a riser gate always should be covered in mold pouring. Pressure is derived from height, independent of volume. Pressure at any point in the mold equals height of gate above that point divided by 28 and multiplied by the specific gravity of the metal involved. Touching-up a head gate aids feeding, but yields no additional intensity of pressure. A leak in the gate reduces pressure in the mold. If the shrinkage cavity in a pouring gate descends to the gate's lowest point, its extension upward or increase in its volume is requisite.

"Correct pouring of a mold has a distinct bearing on the accomplishment of its gates. Gate pin holes in the casting result from a variety of causes. Among them are hard ramming, wet sand, lack of pressure, improper construction or placement, double gating and cold metal. Double gates of unequal volume, or those attaching to light and heavy casting section respectively superinduce shrinkage. Pouring should be started in a feed gate the moment metal from the mold enters the same, otherwise

the gate may freeze or its colder metal may be driven back into the casting, porosity resulting. The same applies to the double pouring of molds.

"A stream of metal playing throughout pouring on a given core surface, is likely to burn the core solid at the contact point. Gating from one casting to another admits a chance of both being bad. A single gate cut at such an angle as will direct the metal current to a circular motion in the mold answers best for ring-shaped castings. Double gating superinduces drawing, sends two streams meeting at a point opposite the button gate, depositing all their dross at that point and often failing to unite properly.

Shrinkage Results from Two Causes

"Cope shrinkage usually is a consequence of cold metal and poverty of pressure. Drawing can follow the same, though it is just as likely to result from variation in bulk of metal. Both are consequential also to errors in molding practice. Every pressure gate should slightly and uniformly overtax its mold-resisting power. I don't like an absolutely finless casting. Heavy work delivery gates require that volume only will satisfy the demands in the critical zone of the casting, which critical zone is the vicinity of gate attachment. It is folly to so volume all gates as to out-liquidate, in entity, their castings.

"High temperature metal is most exacting on gates. Cold metal creates greater friction but forms its own protection by its surface congealation. Scientific gating makes dead-sure of everything happening in gate connection. Before putting them in service, all set gates should be tried out thoroughly and investigated, and the logic of theory thus checked against the infallible logic of results in practice."

In an alloy of given analysis those samples with greatest strength and tenacity, which possess highest specific gravity will usually be the soundest, both as indicated by pressure tests and as shown by microscopic examination. The actual fissures due incipient shrinkage are responsible for porosity, weakness, lack of ductility, and low specific gravity.

The effects of incipient shrinkage usually occur in the section of the casting last to solidify, and between the primary dendrites. In any campaign for the elimination of porosity the starting point is the drawing board. Logical design is needed, and the preservation of uniform metal sections highly desirable in some cases absolutely essential.

Sound gating practice is the next step. Bronzes and red brasses have long freezing ranges and their fluidity or mobility in the pasty stage is low. Care should be taken to see that risers really feed the castings. The tops of risers and the ingress gate (sprue) should pull down that is to say be concave. In theory the gates generally should go to the thin sections, thus starting freezing in the heavier sections first and (with flowing metal) having the last hot metal finally fill the thin section. This tends to equalize cooling rates. The foundry practice must be modified to fit the individual case.

Molds and cores should be clean, open, and not too hard. Localized porosity quite frequently is caused by sand, dross, slag, coldshuts, draw cracks and tears. Localized internal shrinks or drawholes may be a healthy sign as they indicate the metal is shrinking good. They usually are easily combated, and the trouble is local not general as is the case with incipient shrinkage. Drawholes should be whipped by gating, design changes or pouring temperature rather than by alterations in furnace practice.

Good raw materials are essential for production of best quality castings. Highest grade engineering and pressure castings are not made from miscellaneous scrap. All virgin metal charges are not essential and excellent castings can be and are made from properly refined composition ingot. Impurities such as aluminum and silicon are extremely detrimental, but if not excessive often may be eliminated by partial oxidation of the bath. However the surest way to avoid trouble is to purchase metal free from such impurities.

Silicon Obtained from Lining

Under highly reducing conditions silicon may be obtained from the furnace linings—a condition of affairs that can be avoided by proper furnace practice. Other impurities such as antimony, arsenic, sulphur, etc. should be avoided in selection of the raw materials. Small amounts of lead usually improve the soundness of bronzes and red brasses, as they collect in the interstices between dendrites.

Atmospheric conditions within the furnace have an important bearing on the quality of metal melted therein. Different alloys probably vary in their susceptibility to influence by atmospheric conditions. We need not confuse ourselves with the many conflicting theories concerning the nature of the gases collected in the incipient shrinkage voids. Irrespective of the mechanism and chemical nature of the reactions, two practical facts stand out.

First, heavy oxidation of the metal is bad. High metal loss, numerous inclusions, sluggish metal and incipient shrinkage are usual results. On the other hand melting, and particularly repeated remelting of many bronzes and red brasses under reducing conditions (high carbon monoxide, excess of hydrogen, and gaseous hydrocarbon) is bad, no matter what sort of furnace is employed.

The metal is gassed, its gravity and strength is low, and persistent incipient shrinkage common. Some authorities claim that slightly oxidizing atmosphere is best. Others indicate that a slight excess of reducing gases is desirable. Bolton and Weigand, *Transactions* of the American Institute of Mining and Metallurgical Engineers, 1929, have chosen the middle course, and prefer neutral atmospheres consisting of carbon dioxide, nitrogen, and water vapor.

Large excess of oxidizing or reducing gases is avoided by keeping furnaces under supervision by means of gas analyses. Portevin, St. John, Dews and others indicate the advisability of adding some oxidizing agent to offset direct and indirect bad effects of reducing atmospheres. However, the fact remains that an ounce of prevention is worth a pound of cure.

High Temperature Affects Results

While possibly not germane to the study of unsoundness of most bronzes and red brasses, a practical suggestion may be derived from the finding of Cowan, *Journal* of the Institute of Metals (London), 1927, relative to the microscopic porosity due to the difference in contraction of eutectiferous components in white metals. For example, what are the differences in contraction in bronzes and red brasses between the primary dendritic forms and the metal occuring between these interstices?

Pouring temperature is important. Too high pouring temperature slows down the cooling rate, promotes dendritism, allows time for segregation, gas rejection, etc. Too low pouring temperatures do not allow proper metal flow, prevent feeding and promote incipient shrinkage. As pointed out elsewhere, proper melting conditions permit greater flexibility in pouring range.

However, many investigators, including Karr and Rawdon, Carpenter and Elam, Homfray and Adam, Dewrance, and lately Daniels, indicate that proper pouring temperature gives best results, and when confined to a narrow range may minimize the bad effects of dubious melting conditions in the 88-10-2 alloy. Other investigators confirm that with other alloys. Chilling castings or portions thereof by casting against chills or denseners naturally lessens the tendency toward incipient shrinkage. Obviously that is not economical except in special cases.

In conclusion it may be said that incipient shrinkage is influenced by the general contraction characteristics of the specific alloy and the length of its freezing range; fluidity of the alloy at various temperatures; presence of impurities and dissolved gases in the molten alloy; differences in volume contraction of the components in heterogeneous alloys; rate of cooling of the casting, and the feeding of the casting.

(*Concluded on Page* 76)

Strong Aluminum Castings

Are Obtained by

Improved Foundry Practice

By T. D. Stay, E. M. Gingerich and H. J. Rowe

Part II

LOW green-sand strength of molds is responsible for a considerable amount of casting defects, such as cope drops, sand washes and core crushes. The sand in a mold must have sufficient strength to resist the washing action of the molten metal, to support set-in cores and to withstand jars and knocks to which molds are subjected in handling. These stresses usually are in compression, and the strength of the sand usually is measured by its resistance to failure by compression.

That laboratory test is quite simple and gives fairly consistent results. The usual method is to determine the lower limit of compressive strength of the sand to be used which will give satisfactory results in the foundry and maintain the strength above this limit.

Compressive strength tests are not always an accurate measure of the worth of the sand. A high moisture content in sand which is well *burnt out* often will give good strength when tested but will result in cope drops and washes in the foundry. A good sand is one which can be worked dry without losing much of its cohesiveness.

Study Is Necessary

FOUNDRY variables have considerable effect on the properties of the castings. Variables include the sand, cores, application and location of chills, methods of gating, risering, etc. These must be considered carefully when entering into production of any casting. Study of a few sample castings made under different conditions will point the way to obtain castings with the desired properties. This article is the second of two abstracted from a paper presented at the annual meeting of the American Foundrymen's association held in Cleveland May 12 to 16. The first appeared in the Dec. 1 issue.

The strength or cohesiveness of the sand is determined largely by the kind and amount of bonding material and the moisture content of the sand when ready for use. This necessitates first the selection of a sand with a desirable degree of permeability and strength. These properties then must be maintained in the foundry by controlling the moisture content and adding new sand or some artificial binder to maintain the proper strength compatible with permeability.

The use of cores in aluminum-alloy castings presents a number of problems which greatly affect the production of good castings. In general, a core should have sufficient strength to be handled without excessive breakage, and should withstand the strains induced by metal pressure in the mold.

Cores which are surrounded by molten metal must have a high permeability to permit easy escape of the relatively large volumes of core

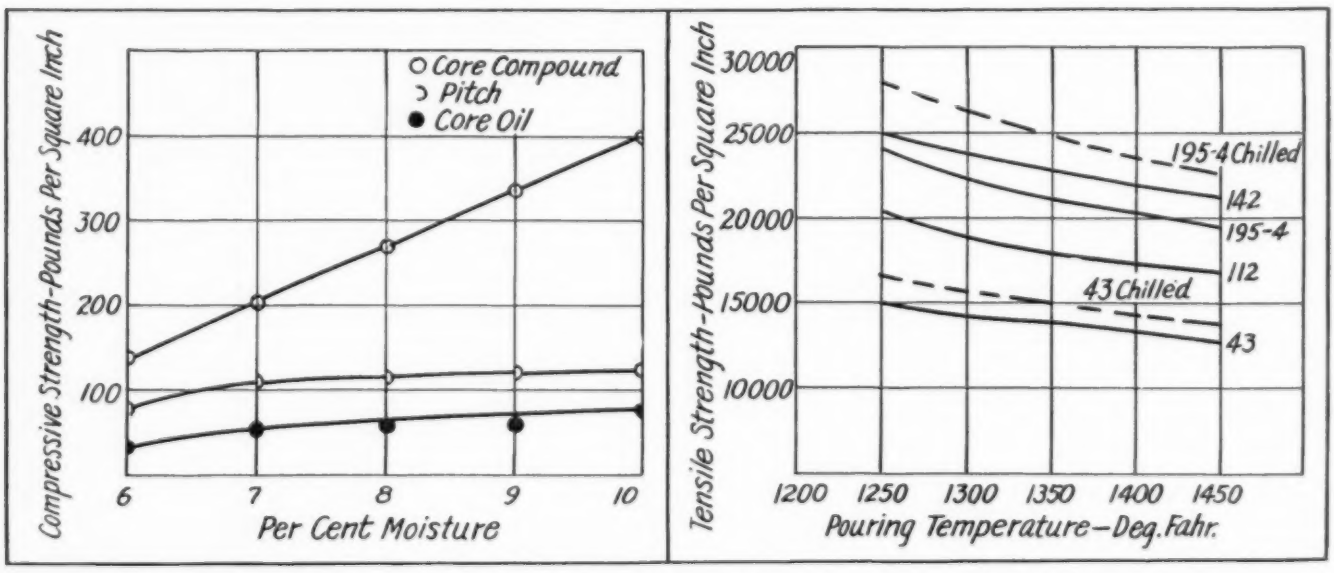

Fig. 4—Moisture Effect on Compressive Strength of Cores Made with Various Commercial Binders. Fig. 5—Effect of Pouring Temperatures on Tensile Strength. Test Specimens from ¾-inch Sections. Melting Temperature 50 Degrees Fahr. above Pouring Temperature

gas generated. Cores have a natural high permeability, due to the coarseness of the sands generally employed; but this should be augmented by venting cores as much as possible. This practice will do much toward eliminating blows and porosity in castings.

It is known that aluminum alloys have a large linear contraction and are hot short. Hence, it is essential that cores in thin-walled castings be soft and easily crushed by the casting when it contracts. If the core is too strong or hard, a crack invariably will develop.

Many varieties of sands and sand mixtures are employed for cores, depending upon the source of supply and the class of work. Lake sands and local bank sands find wide use in core-sand mixtures.

There are a number of binders used, depending also upon the kind of core desired. Binders which give off an excessive amount of gas when in contact with molten metal should be avoided.

The important thing about core-sand mixtures is that they should be made up according to the requirements of the cores. Body and housing cores should be soft. Ram-up cores should be hard. Jacket cores should be permeable.

Therefore, core sands, and particularly binders, both kind and quantity, and moisture content must be controlled closely to obtain the best castings. For example, the strength of cores made with certain corn-compound binders increases rapidly with increased moisture content in the sand mixture, as shown in Fig. 4.

Improper foundry practice often is responsible for casting defects such as shrinkage and cracks. These defects are easily visible when they are external, but only X-ray examination or fracture will reveal these defects when they are internal. Cracks sometimes are so fine that only the severe quench of the heat-treating operation will expose them.

Many of these casting troubles originate in the character of the metal, namely, high shrinkage at solidification, large coefficient of contraction and hot shortness. Since these properties are inherent in aluminum, their effect upon castings can be minimized only by proper foundry practice, such as gating and use of risers and chills.

The ideal cooling condition for sound castings is a uniform, rapid, progressive solidification proceeding from points farthest from the gates toward the gated area. Such progressive cooling should be worked out for each particular type of casting so that the metal as it solidifies and shrinks is fed by molten metal immediately adjacent. This condition is obtained by proper gating and use of risers and chills.

Fig. 6 as follows: A—Angle as designed without fillet. Cracks occurred at corner even when chilled. B—Same as A, with fillet and chill in corner. Note elongated grains due to chilling. This type of structure is susceptible to cracks. C—Same as B, after heat treatment, showing that structure remains the same. D—Original section with fillet but without chills. Cracks still occurred, due to nonuniform cooling of light and heavy sections. E—Filleted section with chill on outside of heavy section only. Note uniformly fine grain, resulting in elimination of cracks.

The method used to overcome internal shrinkage will depend somewhat on molding and trimming considerations, as well as on the type of casting. For heavy castings, a combination of chills and risers com-

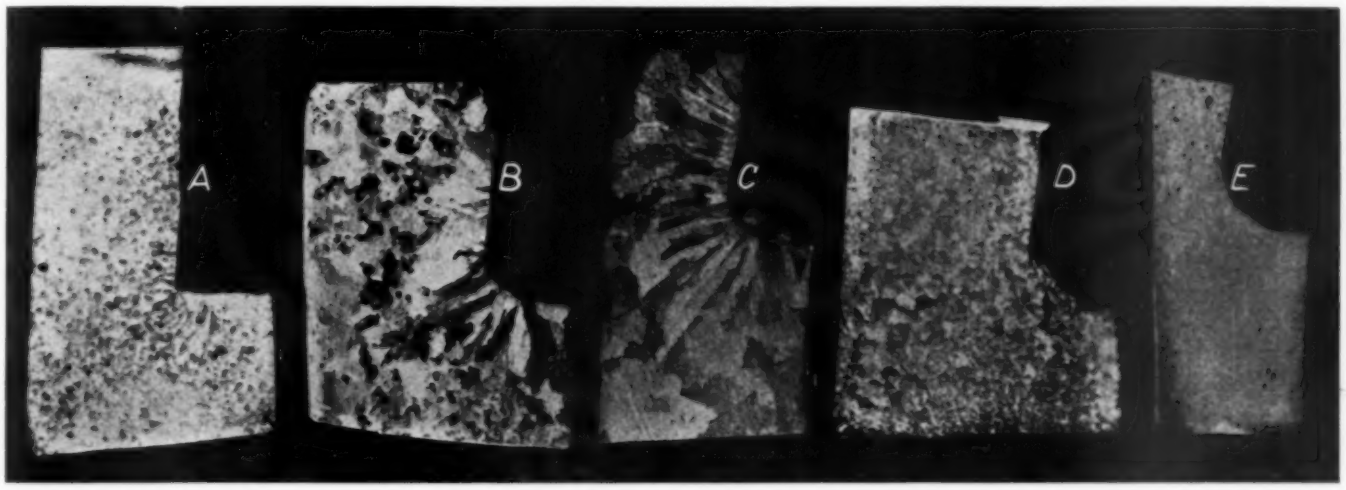

Fig. 6—Effect of Various Methods of Chilling on Grain Structure of Angles Formed by a Heavy and Light Section

Internal shrinkage, which indicates primarily a lack of feeding, usually occurs in heavy sections, such as lugs or bosses, and in junctions between heavy and light sections. Risers at such points usually will correct the trouble. Shrinkage may be overcome also by gating into the thin sections, thereby delivering colder metal to the heavier sections.

It is often advisable to employ chills to hasten solidification in certain parts of a casting. Such practice may be necessary to obtain the ideal, uniform, progressive rate of solidification. Chills also are used when a hard surface is desired. It often is necessary to use risers when the chilled sections are quite heavy in section.

Over-chilling must be guarded against because it may produce a columnar grain structure which may weaken the casting to the point of cracking. The proper placing of chills also is important as shown in Fig. 6. They should not be placed so that they affect the structure of adjoining thinner sections. The effect of chill location is shown in

monly is used. In small castings, chills or risers may be used.

Chills are preferable unless the shrinkage occurs at a point difficult to chill, such as the cope side of a cored casting. In such instances, risers should be used even though they cause more trouble in the trimming room.

Cracking in aluminum-alloy castings is due largely to hot shortness at temperatures slightly below the solidification temperature in conjunction with natural lineal contraction. There are, of course, a number of immediate causes for cracks. Of these, a difference in degree of solidification in various parts of the casting is, perhaps, the most important.

For example, one part of the casting will be solid and begin to contract, while an adjacent section still is soft. This latter section will be unable to resist the contraction stresses set up, and a crack will result. The presence of dross or porosity in such sections will accentuate the tendency to crack. The remedy for cracking, then, is to hasten solidification in the weak sec-

tions by the use of chills or by rearrangement of gating to deliver colder metal to these points.

Use of risers has an important influence upon cracking. A riser may be needed at a certain point to eliminate internal shrinkage where such shrinkage may be responsible for a crack. On the other hand, the riser may be too large or entirely unnecessary. This would have the effect of keeping the section, which it is supposed to feed, molten for too long a time, and would also result in a crack.

Risers and sprues must not be placed too close to the cross bars in the cope flask. Otherwise there

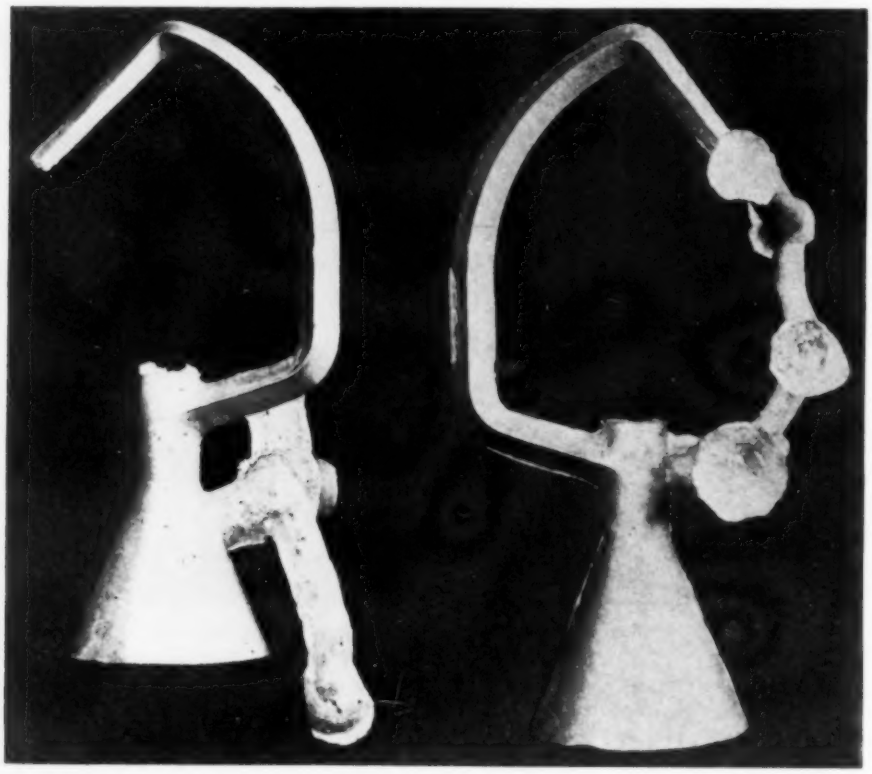

Fig. 7—Original and Improved Methods of Gating a Dough Mixing Beater. Breakdown Test, Original Gating, 2515 Pounds; Same Test, Improved Gating, 3990 Pounds Load

is danger that the casting will become anchored and not be free to move when it contracts, thereby causing cracks. A similar condition exists when the sand has been rammed too hard.

These physical influences of risers and sprues may be lessened in several ways. Besides keeping them away from the cross bars, the risers and sprues may be cut away partially from the casting while they are still soft. Wedges may be placed adjacent to them in the mold and removed as soon as possible. In some instances the mold may be lifted from the drag board to prevent the sand from offering undue resistance to contraction.

Dissipation of heat to promote more rapid cooling, which is one of the functions of chills, may also be accomplished by the use of fins. Small castings of fairly uniform sections, which on account of design are prone to crack, may be saved by cutting a thin fin in the mold at the weak point. This fin not only will promote more rapid cooling but will have a strengthening effect.

Quite often the crack will occur in the fin but stop short of the casting. At the same time, runout fins may start rapid cooling in locations where it is not desired and cause cracks because of their chilling effect. The use of thin fins, hence, requires considerable thought and much work can still be done in this connection.

Aside from its effect upon internal shrinkage and cracking, gating has an important influence upon the strength of a casting. If a single gate or a few gates are employed, considerable hot metal will enter the mold at these few points, and these sections will be weak on account of the resulting coarse grain structure.

If these sections happen to be highly stressed in service, they may fail with disastrous results to both customer and foundry. For this reason, multiple gating should be used whenever possible to reduce gradients in metal temperature between different sections of the casting.

Castings should not be gated in sections subject to severe stresses in service. Fig. 7 illustrates the increase in strength experienced through a change of gating, resulting in a 60 per cent increase of strength as measured by a comparison of breakdown tests of the castings.

The necessity for proper care of melting and holding pots and pouring ladles cannot be stressed too greatly, since the effect of contamination of metal from dirty equipment of this type often is serious. Although most foundries realize the importance of clean equipment—not only with aluminum alloys but with all ferrous and nonferrous metals—there are still a few who overlook this point and often run into difficulties.

The chemical composition limits of aluminum alloys are maintained to give certain characteristics to the alloy, among which are its physical and casting properties. To destroy the composition by the addition of foreign metallic elements picked up during melting and pouring, means that some property of the metal is being destroyed or weakened, usually resulting in subsequent foundry difficulties.

Equipment Should Be Clean

It is a comparatively easy matter, especially in jobbing foundries using a variety of ferrous and nonferrous alloys, to contaminate the metal either through a mixing of the scrap or by melting or pouring from equipment used previously to melt other metal and not thoroughly cleaned prior to charging the aluminum alloy.

It also is comparatively easy to establish a system whereby scrap from the various alloys can be kept separate and melting and pouring equipment cleaned between heats of different alloys. Such a system will aid materially toward stronger aluminum-alloy castings and less foundry difficulties.

Particular care must be taken in the melting of aluminum-silicon alloys, especially in iron pots, since their affinity for iron causes a rather rapid pickup of this element. Iron in excess of certain limits affects both the physical and casting properties of these alloys, and anything that can be done to eliminate unnecessary iron pickup is to the foundrymen's advantage.

The best protection against iron pickup has been found to be a coating of white-wash or clay-wash on the interior of all iron melting pots and ladles, and on all other iron equipment which comes in contact with the molten metal. Such coatings should be applied at least once a day for satisfactory protection, and to all the iron equipment regardless of whether it is used in handling silicon alloys or not.

Aluminum alloys should be poured at as low a temperature as will fill the mold readily without causing cold shuts. It has been shown that a high pouring temperature will tend to cause unsoundness and low strength in castings thus poured.

Melting temperature is, of course, a function of the pouring temperature, but should be no higher than to compensate for the natural drop in temperature between the melting furnace and the mold. This is, of course, not always possible to do. On the other hand, while a pot of metal may have to be cooled 20 degrees Fahr. before pouring, there is no excuse for this being 120 degrees Fahr. instead.

The effect of high melting temperature is overcome only partially by allowing the metal to cool to the proper pouring temperature. Grain size, shrinkage and porosity are less when the metal is not overheated in melting. Shrinkage and porosity are affected by iron pickup, oxide formation and gas absorption, which may occur at high melting temperature. Temperature alone affects grain size, which in turn is associated with surface shrinkage.

Coarse Grains Form

For best results, metal should be used shortly after it has reached the proper melting temperature. It has been shown that soaking tends to cause the formation of a coarse grain structure and to promote surface shrinkage. In addition to this, soaking will tend to increase iron pickup in iron melting pots, as well as oxide and dross formation.

It often has been noticed that the top surface of an ingot poured from soaked metal will show a relatively coarser crystal structure. The shrinkage cavity often is deeper and more spongy than if the metal were poured without being soaked. Similar conditions exist when the metal is poured in castings as well as in ingots.

Control of melting and pouring temperature makes necessary pyrometric equipment for the purpose of measuring and recording temperatures. Each melting furnace should be equipped with a thermocouple. In addition, metal temperature should be checked immediately before pouring.

Suitable equipment for such temperature control has been fully described elsewhere. It is essential that this equipment be kept in good condition and inspected daily if the best results are to be obtained.

A great many casting defects resulting in low-strength castings can be attributed to faulty pouring technique. As a rule, such defects as shrinks, cracks and blows can be eliminated by the proper gating, application of chills and sand control. Occasions arise, however, when not only these but other defects such as misruns and cold shuts can be overcome by the proper rate and steadiness of pouring at the correct pouring temperature.

The pouring of every casting should be so timed that the pattern cavity will fill fast enough to prevent cold shuts and misruns, and at the same time slow enough to promote uniform progressive solidification. The stream of metal entering the sprue should not be broken at any time during the pouring operation, and should enter without splashing or violent agitation.

The effect of pouring temperature cannot be overestimated, and accurate control after the correct temperature is determined will always result in better castings. The setting of the pouring temperature for any particular casting is best determined by actual trial.

Several molds can be poured with metal at different temperatures, starting with metal known to be hot enough and dropping the temperature on each successive mold until a misrun occurs. A temperature 20 degrees Fahr. higher than this lowest temperature should then be designated as the pouring temperature of the casting. The additional 20 degrees Fahr. is sufficient factor of safety to take care of the allowable variation in the temper of the sand and rate of pouring.

Once the pouring temperature is set by actual test it should not be changed or varied unless, of course, the method of gating the pattern is changed. Guesswork should be eliminated as far as possible from temperature control, since the temperature at which a casting is poured has an exceedingly great effect upon its physical properties.

Good Castings Produced

A casting poured at the lowest possible temperature will have finer grains, less defects and higher physical properties than will the same type casting poured at any higher temperature. The effect of pouring temperature on the physical properties of test bars machined from a $\frac{3}{4}$-inch sand-cast section is clearly shown in Fig. 5.

After once determining the pouring temperature of a particular casting, it is quite desirable to maintain a melting temperature just enough above this to allow only for the unavoidable cooling which takes place during the handling.

In the smaller foundries with rather limited furnace capacity, it often is necessary—when a number of castings are being poured from one furnace—to vary this procedure somewhat and maintain the melting furnace at the temperature necessary to take care of the casting with the highest pouring temperature. For those castings requiring a lower pouring temperature, either the metal must be held in the pouring ladle until the desired temperature is reached or an accelerated cooling must be produced by some approved method.

Cast-iron chill rods, coated with white-wash or clay-wash, form satisfactory cooling appliances. The addition of foundry scrap to the molten metal as a means of accelerating the cooling is to be discouraged, as it is the source of much trouble through the fomration of drossy inclusions in the metal.

Directly prior to pouring, the surface of the molten metal should be skimmed quietly and carefully to aid in preventing excessive dross entering the pattern cavity. The metal then should be poured without any further agitation or excessive splashing.

As mentioned before, the rate at which the pouring is done must be timed so that the pattern cavity will fill fast enough to prevent cold shuts and misruns, and at the same time slow enough to promote uniform progressive solidification. To aid further in eliminating dross, the pouring sprue always should be kept full while pouring and the stream of metal should not be broken at any time during pouring.

Pouring Height Varies Properties

It has been found through investigation that the height of pouring, or the distance the molten metal drops from the ladle to the pattern cavity, has considerable effect upon the soundness of the resulting casting. This phase of pouring technique generally is not realized, with a result that many castings are poured without due consideration of this variable.

A sound casting must be free from dross inclusions and air pockets, as well as from the other foundry defects. The amount of dross within a casting is due largely to the agitation of the metal incident to the pouring of it, while trapped air is introduced into the pattern cavity through the sprue while pouring. The possibility of both these conditions becoming harmful increases with the height the molten metal falls from the ladle to the pattern cavity or the pouring height.

Although chokes placed in the gates and runners partially overcome the harmful effects on pouring a casting from an excessive height, they should be used only as a means of further improvement rather than as a *cure-all*. Experience has shown that the soundest and, hence, the strongest castings are those poured from a low pouring height.

The control of foundry technique for the production of stronger aluminum-alloy castings does not stop with the pouring of the castings but must be carried on through the shakeout and inspection. Numerous defects, such as cracks and excessive warping, can be introduced through careless handling of the molds and castings in the shakeout

(*Concluded on Page 76*)

Bake Cylinder Block Cores *in Continuous Ovens*

By E. W. Beach

AUTOMOTIVE castings are intricate and involve a great deal of skill in manufacture. Among the most intricate are cylinder blocks. Difficulties of production do not represent the only hazard in casting those intricate forms for cost also is a major factor. Jobbing shops catering to the automobile trade must be able to furnish the best possible castings at a cost figure which appeals to the automobile company.

Daily requirements of engine castings for automobiles are enormous. New designs have contributed to the speeding up of production or have helped to keep pace with the speed demanded. The core room has not been left behind in that respect. Core making machines, sand mixing devices and continuous core ovens with temperature control have been installed. Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., one of the largest jobbing producers of automobile cylinder castings, has kept pace with those developments. That company has installed ovens of various types to meet its core production problems.

A pair of vertical core ovens operating as a group is used by that company to bake the cores for gates, valves and other small parts which will average about ¼-pound each in weight. The cores are made of lake sand and linseed oil binder, the proportions varying from 1 to 60 to 1 to 80.

Two vertical ovens previously mentioned are placed side by side and are separated by a gravity conveyor and sufficient handling room. A double line of seven core benches, back to back, where gate, valve and other small cores are made, is located behind the loading section of each oven. A 16-inch belt conveyor traveling in the direction of the ovens runs down the aisle between the core benches and passes the oven on the outside. Conveyors are used to carry the green cores from the coremakers' benches to the loading entrances of the ovens. Cores are removed by the oven loader on arrival at the oven and placed on the oven conveyor racks for baking. Each green core conveyor has a safety stop at its delivery end which shuts off its motor in case any core passes the unloader's station.

An endless, double-chain, pipe-spaced conveyor carries the product up into the oven, over the head sprockets and down to the unloading door which is on the same level and opposite the loading entrance. Thirty core racks are carried by each oven conveyor and are swung from the spacer pipes. These racks are 24 inches wide, 66 inches long and 25 inches deep. The racks in the north oven carry two shelves each and those in the south oven three shelves.

A 16-inch gravity conveyor, on which the operator unloading the ovens places the used core plates for return to the core-makers' benches, runs from between the ovens to the far end of the core bench line. Baked cores are placed on lift racks stationed in front of the oven unloading doors.

As the cores rise in the oven from the loading entrance, they enter the baking zone, the temperature of which gradually is increased as the cores pass upward. The baking temperature is 420 degrees Fahr. At normal conveyor speed, one oven has a baking period of 45 minutes and the other 60 minutes. The temperature gradually is reduced as the cores are returned to floor level and are cooled

Heat Controlled

MANY foundries of automobile plants and jobbing shops that specialize in the manufacture of castings for automotive companies, have employed continuous ovens in their core departments to speed production and to reduce core losses. Two types have been adopted, namely horizontal and vertical. In this article, which is abstracted from a description appearing in Industrial Oven Notes, the author explains the construction of the ovens used in the Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., where he is an executive in the engineering department.

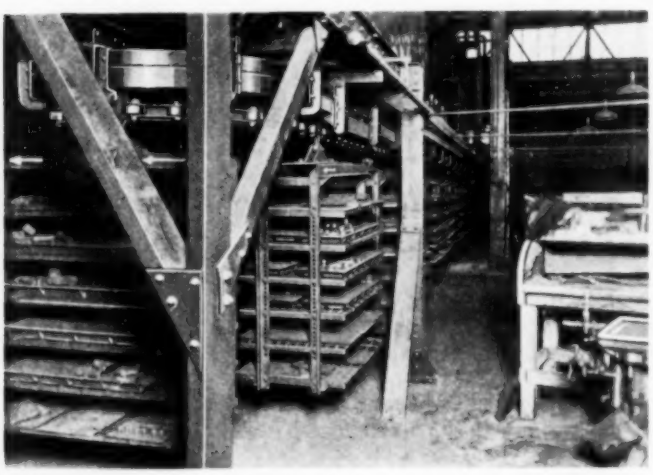

Fig. 1—Crank Case Core Oven on Mezzanine Floor of Plant 1 Where Cores Are Loaded Directly on the Conveyor by the Coremakers. Fig. 2—Carriers Loaded and Entering the Jacket Core Oven in Plant 3

by special cooling fans located above the unloading doors. Each oven is provided with two 18-inch fans and an outlet vent immediately above them. Upon delivery at the unloading door, both cores and core plates are sufficiently cool to be handled comfortably. Core plates weight approximately 10 pounds each.

The oven body is 7 feet 6 inches wide, 10 feet long and 38 feet four inches high. It operates under mechanical ventilation, actuated by a 30-inch fan supplied by the Garden City Fan Co., Chicago. The heating units include two low-pressure, inspirator type burners made by the Surface Combustion Co., New York, and placed one above another, with two safety pilots and necessary baffles.

The gas pressure at these burners is atmospheric, reduced from 10-ounce main pressure, and the air is supplied by a No. 4½ blower made by the P. H. & F. M. Roots Co., Connersville, Ind. The burners normally consume 1400 cubic feet of natural gas per hour in baking 3000 pounds of cores. Heat control is maintained by automatic recording temperature controllers. The controllers act through air flow relays and 3-inch safety valves, designed for 110-volt current.

One Man Loads Oven

Each oven serves 24 coremakers and requires one man to load, one man to unload cores and one man to check and inspect cores delivered to the oven.

The largest oven in any of the three plants is the four pass, trapped-end, horizontal oven in plant 3. That oven is used to bake crank case cores and serves 50 coremakers. These cores vary in weight from forty-five to eighty-five pounds. The oven is 200 feet long, 20 feet wide, and except for the cooling chamber, entrance and exit inclines, stands 17 feet above the main foundry floor level. This permits use of the floor area beneath the oven for coremaking equipment, dipping, loading, unloading, sorting, fitting, inspection and storage. Lake sand is used for crank case cores and is mixed in an 8-foot, muller type mixer, made by the National Engineering Co., Chicago. Linseed oil is used as a binder in the proportions of one part of oil to 60 parts sand by volume. All the coremaking operations are concentrated closely around the oven.

Provision has been made for 25 coremakers on either side of the aisle adjacent to the oven. A light auxiliary overhead trolley conveyor runs down the center. Core racks are suspended from the conveyor. Shelves of the conveyor are 30 inches above floor level in the aisle previously mentioned and the conveyor chain 60 inches above the same datum line. The aisle between the benches is 13 feet wide so that coremakers can load their completed green cores on the auxiliary conveyor as the racks pass the stations, without leaving their positions.

This conveyor carries the green cores past blacking tank No. 2, which is on main floor level with its tank table at the same elevation as the core plates carried on the top shelf of the conveyor rack. The tank operators slide the core off the conveyor rack and on the tank table, preparatory to dipping it in the plumbago blacking solution. Ten feet beyond tank No. 2 is located tank No. 1, but on a level 18 inches below tank No. 2 and even with the bottom conveyor rack shelf. A vertical curve in the auxiliary conveyor line between the two tanks bring the rack level also to the same elevation as the table of tank No. 1, where cores are handled

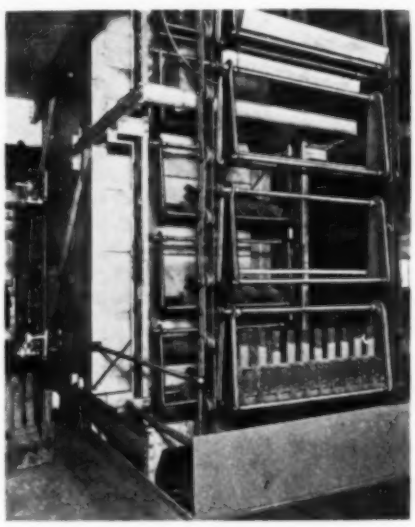

Fig. 3—Unloading Point on the Main Assembly Floor of the Vertical Oven for Drying Blacked Cores

in the same manner. Alternate racks are emptied at each of these tanks. After the cores are dipped at those stations, they are placed on the respective shelves of the oven conveyor rack.

Beyond tank No. 1, the auxiliary conveyor runs in a subway around a depressed traction wheel, then beneath the floor of the cooling chamber and finally upward to a point opposite the oven exit. At that point the shelf of the auxiliary conveyor rack is at the level of the bottom shelf of the oven conveyor rack. Both conveyors run parallel and travel in the same direction. Baked cores from the bottom shelf of the oven conveyor rack are transferred to the auxiliary conveyor rack at that point. A subsequent rise brings the auxiliary conveyor rack to a level with the top shelf of the oven conveyor rack, where the remaining cores from the oven conveyor are transferred to the auxiliary conveyor.

This arrangement frees each shelf of the oven conveyor just ahead of its respective loading point. The auxiliary conveyor continues under the elevated floor of the oven to its extreme northern end and then passes around two 90-degree turns to again start down the aisle between the core benches. On the stretch from the point where baked and green cores are transferred to the turn at the north end of the oven, the cores are removed from the auxiliary conveyor for fitting, inspection and storage. Core plates are left on the racks for return to the coremakers. Cores for storage are loaded on and moved to their destination by lift trucks.

The oven conveyor is 812 feet long and travels normally at 30.1 inches per minute, although this speed can be increased readily as much as 100 per cent or decreased to 50 per cent of normal as the occasion demands. Each shelf of the oven conveyor racks measures 34 x 36 inches and holds 10 to 12 cores according to the size of the plate used. There are 161 racks spaced 5 feet 4 inches center to center. On the basis of 10 x 12-inch core plates, 508 cores are run per hour at normal speed and using 11 x 17-inch plates, 338 cores per hour is normal production. The conveyor makes a complete circuit in 5 hours and 24 minutes at normal speed, divided as follows: Baking time, 4 hours; cooling time, 58.3 minutes; loading and unloading time, 17.9 minutes; idle time, ascending entrance incline, 7.8 minutes.

Has Four Heat Zones

The conveyor drive is located on top of the cooling chamber and acts through a drive sprocket directly below and inside the chamber. It includes a 440-volt motor, a variable speed transmission and speed reducer. This conveyor was fabricated and installed by Palmer-Bee Co., Detroit.

The crank case oven has four heat zones, one for each of the four passes of the conveyor through the oven. The first zone extends from the head end of the entrance incline to the first conveyor turn at the north end of the baking chamber and the fourth zone from the other corresponding turn at this end of the oven to the head of the exit decline. A temperature of 515 degrees Fahr. is maintained in zone 1, 470 degrees Fahr. in zones 2 and 3 and 450 degrees Fahr. in zone 4.

Twenty-four direct burners, supplied by the Surface Combustion Co., New York, with 16 safety pilots, constitute the heating elements in this oven. They are controlled by four controllers, which operate four, 4-inch, motor-driven, supply valves, one for each heat zone. Inspirators for the burners are supplied with air from an air turbine delivering 2250 cubic feet per minute at 20 ounces pressure. That turbine is direct connected to a 20 horsepower motor. Heating system consumes 8000 cubic feet of gas per hour at normal operating speed

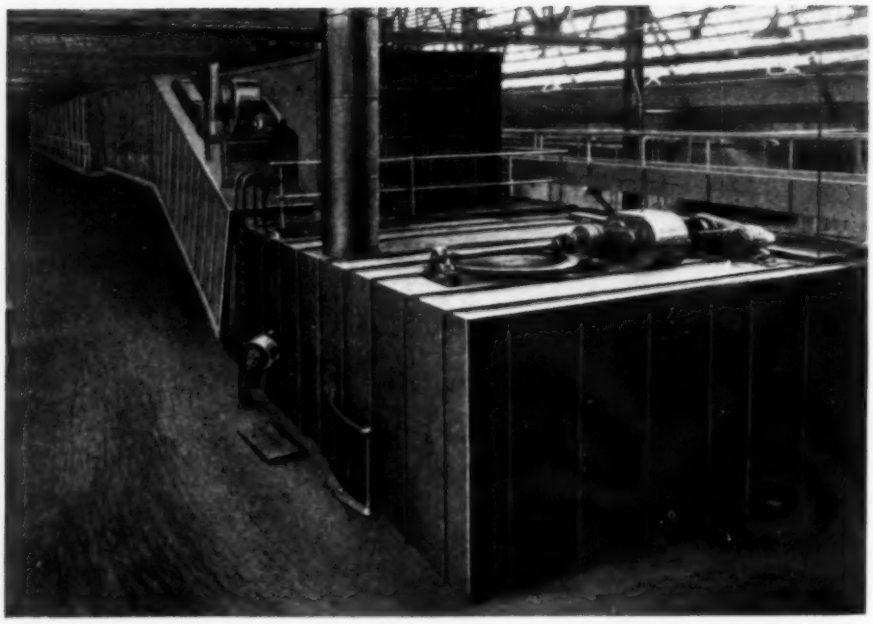

Fig. 4—Crank Case Core Oven Located in Plant 3, Showing the Conveyer Driving Mechanism

and dries 38,000 pounds of cores saturated with blacking solution.

The cooling system consists of a fan supplied by the Clarage Fan Co., Kalamazoo, Mich., driven by a 5 horsepower motor and four, 24-inch fans, each equipped with a ¾-horsepower motor. These units are located at the exit decline end in the cooling chamber of the oven. That equipment delivers 4000 cubic feet of cooling air per minute.

A three-pass horizontal, trapped-end oven, used to bake jacket cores and other small cores which will vary in weight from 8 to 19 pounds each, also is located in plant 3. That oven is a single-compartment, continuous, conveyor unit 8 feet 2¼ inches wide at the ends, 12 feet 6 inches wide through the center section, 8 feet high inside and 117 feet 6 inches long. Like the crank case oven, the floor area directly beneath the oven not utilized for inclines is used for coremaking and other operations associated with the production of cores. The entrance incline of the oven is near the west end and the exit decline midway between the ends of the oven on the north side. The oven conveyor emerges from the cooling chamber, is brought around a 90-degree turn and traverses the width of the unit to a second turn just beyond the south oven wall. From this point it parallels the wall to a point beyond the entrance incline where a 180-degree turn brings the conveyor into the oven entrance.

Coremakers Load Cores

The coremakers' benches and molding machines, supplied by the International Molding Machine Co., Chicago, are stationed on both sides of and parallel to the conveyor in its passage along the south oven wall. Each coremaker loads his own cores on the racks carried by the oven conveyor. Unloading is completed while the rack is passing along the transverse run after leaving the exit decline of the oven.

The oven conveyor is 373 feet 4 inches long, with a counterweight take-up at the traction wheel turn just ahead of the entrance incline. It carries 70 racks spaced 5 feet 4 inches apart. These racks each carry 6 shelves 28 inches wide and 40 inches long. Normal conveyor speed is 20 inches per minute, which allows 3 hours and 44 minutes for one complete cycle. The complete cycle includes 2 hours baking time, 36 minutes cooling time, 51 minutes loading time, 11 minutes for unloading and 6 minutes idle time in ascending the entrance incline. Normal speed may be increased to 40 inches per minute or decreased to 10 inches per minute by the variable speed transmission between the motor drive and the speed reducer.

Two sizes of core plates are used, the smaller 11 x 28 inches and the larger 12 x 38 inches. Using the larger plates and operating the oven at normal speed, 225 cores are baked per hour. Hourly production is 338 cores on the basis of the smaller plates and normal speed. The heating equipment of the jacket core oven consists of 9 lava-tipped, direct burners, for low pressure inspiration. An air turbine of 1100 cubic feet per minute capacity supplies the air for those units. This turbine is direct connected to a 10-horsepower motor.

Natural gas is used as fuel and normal consumption is 3600 cubic feet per hour with all burners in operation. This produces an operating temperature of 450 degrees Fahr. in zone 1, which extends from the head end of the entrance incline to the 180-degree conveyor turn at the east end of the baking chamber. Normal temperature is 440 degrees Fahr. in zone 2, which includes the straight run from the end of zone 1 to the west end of the oven. At normal speed and operating temperature, the oven bakes 6000 pounds of cores per hour, having a 6 per cent moisture content. This oven takes the output of 25 coremakers with two men to unload the baked cores.

The counter flow principle is used in ventilating the oven. A 45-inch fan furnishes the air. Cooling air is supplied by a fan mounted on the roof of the exit decline and two, 24-inch fans, blowing a current of air from either side of the decline just above floor level. Cooling fans deliver 4000 cubic feet of air per minute. Oven temperature is governed by two temperature controllers which operate motor driven gas valves on the fuel line.

Plant 1 is the oldest foundry unit of the three plants, and has limited

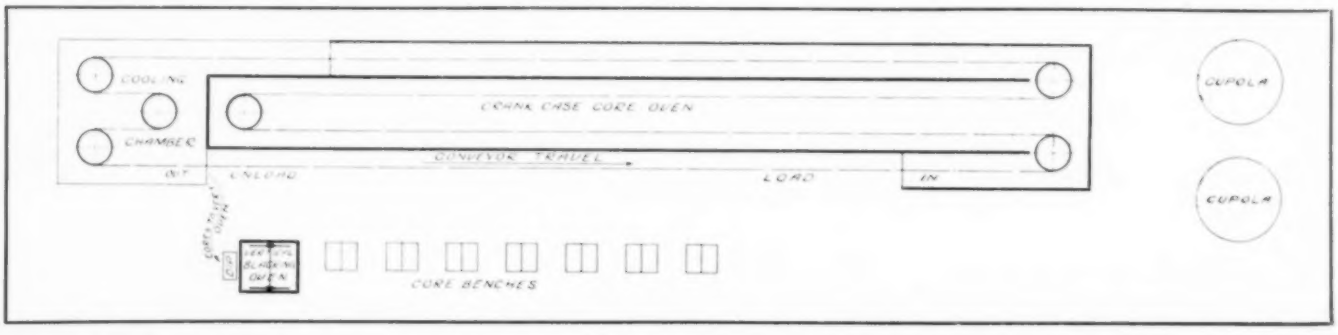

Fig. 5—Layout of Crank Case Core Oven Located in Plant 1 Showing Routing of the Cores Through the Horizontal Baking Oven to the Vertical Blacking Oven

head room, especially in the core department which is located on a mezzanine floor where the clearance under the roof trusses is only 9 feet 2 inches. The most interesting feature of the core department in this plant is the equipment for, and methods of handling the top core slabs and the seven-bearing crank case cores. The layout consists of a large three pass, horizontal, core oven and a vertical blacking oven, with the necessary sand handling equipment and coremaking machines. Fig. 5 shows the coremakers benches paralleling the oven conveyor line. Coremakers load their cores directly on the conveyor racks.

Crank case cores are baked before they are blackened in this plant. When the crank case cores emerge from the exit end of the cooling chamber of the large oven, they are removed and passed to the dip tank of the vertical blacking oven. Cores are loaded on the racks of the blacking oven after being dipped and are dried. Core plates remain on the conveyor and are removed by the coremakers.

The conveyor for the crank case core oven is 569 feet 3½ inches long, carries 107 five-shelf core racks and normally travels 18 inches per minute, although this speed can be varied from 9 inches per minute to 36 inches per minute. It takes the conveyor 6 hours 19 minutes to make a complete circuit. That allows 4 hours 10 minutes for baking, 1 hour 4 minutes for cooling, and 1 hour 5 minutes for loading and unloading.

Core racks measure 32 x 42 inches, with 9 inches clearance between shelves and accommodate core plates 13 x 31 inches which weigh from 20 to 25 pounds apiece. Each rack has a capacity of 15 cores or three to a shelf.

The core oven is 128 feet long, 14 feet wide and 8 feet high inside. It is heated by 15 direct burners for low pressure inspiration. An air turbine driven by a 7½-horsepower motor furnishes the burners with air and a 55-inch fan handles the mechanical ventilation for the oven. As in the case of the other horizontal ovens, temperature is controlled automatically. Operating temperatures normally maintained are 440 degrees Fahr. in zone 1, 480 degrees Fahr. in zone 2 and 470 degrees Fahr. in zone 3. Maintenance of those temperatures requires 6000 cubic feet of gas per hour. This fuel consumption handles 12,000 pounds of sand with 6 per cent moisture content.

Typical cooling equipment includes one No. 2 fan made by the Clarage Fan Co., Kalamazoo, Mich., and two 18-inch fans, each of the latter being driven by a 3-horsepower motor.

As previously noted, this oven is loaded on the mezzanine floor with baked cores coming directly from the large crank case oven. The direction of travel of the conveyor at this loading station is upward. The conveyor passes over a 180-degree turn just under the roof trusses above the mezzanine floor, then downward below the level of the main assembly floor directly below the mezzanine, then upward again into the oven body, which extends from the main assembly floor to the ceiling of the mezzanine floor. After traversing the complete oven heights, the conveyor returns to assembly floor level, where the dried cores are removed and placed on lift racks for delivery either to storage or to the molders.

It takes 55 minutes for that conveyor to make one complete cycle, traveling approximately 2.45 feet per minute. It is a double-chain, pipe-spaced conveyor with racks swung from the spacing pipes. The racks consist of end plates and two pipes on 8-inch centers to support the cores which stand vertically in the rack. Each rack accommodates ten cores. Cores weigh approximately 50 pounds each and after dipping are dried at the rate of 240 per hour at a temperature of 470 degrees Fahr.

The oven is heated by natural gas with burner equipment similar to the other ovens already described. The oven structure is 24 feet 6 inches high, 7 feet 2 inches wide and 8 feet 2 inches deep, with the burners and controls between the main assembly floor and the mezzanine floor. Ovens described in this article were designed by Young Bros. Co., Detroit.

ReducesProductionCosts

(*Concluded from Page* 45)

contents of the hopper are discharged into a waiting truck and dumped.

The prepared sand is discharged from the mullers into a grab bucket suspended from a 2-ton hoist made by the Shepard Crane & Hoist Co., Montour Falls, N. Y. The operator of the hoist travels with the load on a monorail which extends from the sand storage bins on the outside of the building to the last hopper over the battery of molding machines. The path of this crane is shown by the dotted line in Fig. 3. Sand from the grab bucket is discharged into the open tops of the magazines over the molding machines as required.

Two hoppers are provided at each molding station, one small for the facing and the other much larger for the backing sand. The sides of the facing sand hoppers are straight and it will be noted also that the sides of the large hoppers do not deviate far from a straight line. It is claimed that with the sand used in this shop, this form of construction gives the most satisfactory results.

Red hot castings at the shakeout station are loaded on steel skids, afterward picked up by lift trucks and taken to the old foundry where they are cleaned and heat treated.

Not satisfied with results obtained with former equipment and practice the Lebanon foundry installed a continuous twin oil burning furnace of the pusher type, made by Ryan, Scully & Co., Philadelphia. In the first section of the unit the castings are raised to the proper temperature, approximately 1650 degrees Fahr.—the actual temperature employed varies with the carbon content—then given an air quench in the open space between the two furnace units and then placed in the second unit of the furnace where they are tempered or drawn at a temperature of 1250 or 1275 degrees Fahr. All stages of the process are under close pyrometric control. It is claimed that this is the first furnace of its kind in any steel foundry in the United States.

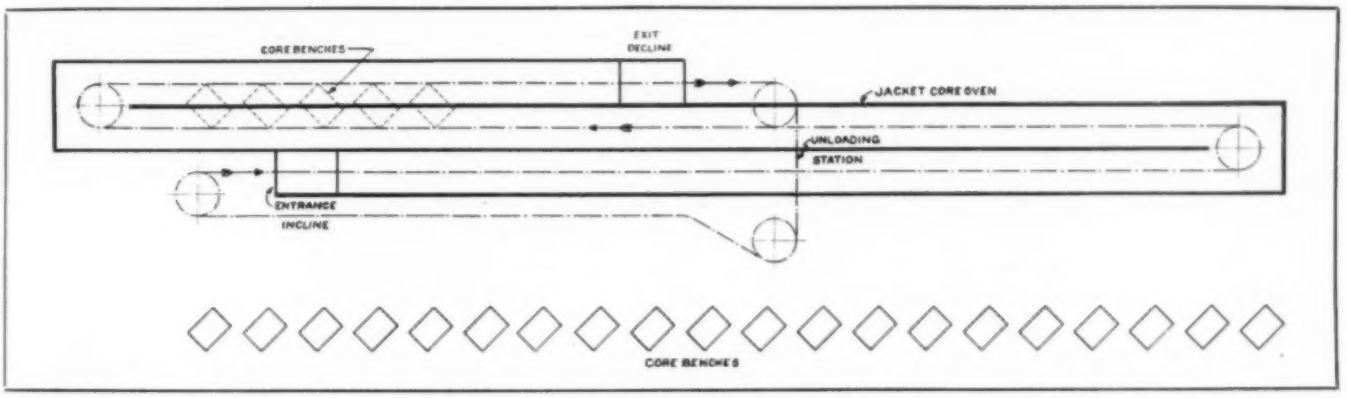

Fig. 6—Layout of Jacket Core Oven Showing Loading and Unloading Stations, Coremakers Benches, and Conveyor Circuit

WHAT OTHERS ARE THINKING

Abstracts Selected from the World's Foundry Literature

Gives Properties of New Alloy

A New Silicon-Zinc-Copper Alloy, by Dr. E. A. Vaders, *Metal Industry*, Oct. 3 and 17, 1930.

Silicon has been limited to use as a deoxidizer in nonferrous metals but its effect on copper alloys has been investigated by many metallurgists. The limitation has been due to the formation of a constituent which renders the alloy brittle. Recent investigations have shown that commercially valuable alloys of copper containing more than 2 per cent silicon may be produced, if the copper content exceeds 70 per cent.

In a study of copper alloys containing varying percentages of zinc and silicon it, was found that, in alloys containing more than 86 per cent copper, the melting point was lowered regardless of whether silicon or zinc were added and that the lowest melting point alloy was the one which contained the highest silicon and zinc contents. However, increasing silicon lowers the melting point to a greater extent than corresponding amounts of zinc. In alloys having a constant zinc content with varying copper and silicon, those with the highest silicon content had the lowest specific gravity.

Sand cast alloys of the silicon zinc copper system have high tensile strength and reasonable ductility. One alloy containing 82.70 per cent copper, 4.89 per cent silicon ,and 12 per cent zinc developed the following properties: Tensile, 32.3 tons per square inch, elongation 10 per cent, and brinell hardness, 155. Alloys with 70 to 90 per cent copper make good casting alloys and some have a tensile strength exceeding 35 tons per square inch while others have an elongation of 40 to 50 per cent.

The addition of tin to the previously mentioned alloys reduces their tensile and elongation while nickel increases the hardness and lowers the tensile strength. Additions of tin increase the value of the silicon-zinc-copper alloys as bearing metals.

Alloys of the silicon-zinc-copper system pour easily, have the tensile properties of aluminum bronzes, give solid castings free from internal pipes, have sufficient fluidity to pour sections 2 millimeters (approximately 0.08 inches) thick easily and the tensile strength to a large extent is independent of the thickness of the test piece. An alloy of 81 to 82 per cent copper, 4 to 5 per cent silicon and 14 per cent zinc makes good chill castings. Alloys of that type have high fluidity, give clean surfaces on the castings and the contraction of the alloy is such that scale may be removed easily. An alloy containing 81.5 per cent copper, 4.5 per cent silicon and 14 per cent zinc may be used in pressure castings. Silicon-zinc-copper alloys machine easily.

An alloy containing 81 to 82 per cent copper, 4 to 5 per cent silicon, 14 per cent zinc and 0.5 per cent tin has been used in bell castings which had tone characteristics similar to tin-bronze bells.

Makes Electric Cast Iron

The Manufacture of Cast Iron in the Electric Furnace, by Walter Lister, *Foundry Trade Journal*, Sept. 4, 1930.

The production of cast iron in the electric furnace has many advantages such as greater control of analysis and melting conditions, any desired temperature may be obtained, and sulphur and possibly oxygen content may be reduced to low limits. Carbon goes into solution at high temperatures and retards the formation of large graphite flakes. Graphite is found finely and evently distributed throughout the metal. High temperature also produces a uniform structure.

Iron melted in the electric furnace possesses close grain, high strength, uniformity, freedom from hard spots, blowholes and undesirable slag inclusions, and excellent machinability and performance. Another advantage of that type furnace is that it is possible to heat the iron to a sufficiently high temperature for many classes of work such as piston rings, valves and other small castings instead of resorting to a high phosphorus to secure the fluidity.

A charge of equal parts of pig iron and scrap is used. Alternate layers of steel and ground anthracite coal, with the first steel on the bottom, are charged into the furnace and melted. Lime then is added since the iron is made in a basic furnace. Pig iron is added in several portions, each charge being allowed to melt before the following is placed in the furnace. When the whole charge is completely melted, it is rabbled well and a sample taken. The condition of the bath is ascertained from the sample and the ferroalloys added. Carbon and slag are adjusted and the temperature is raised to the desired point. When the bath is ready it is tapped. Tapping temperature is generally approximately 1400 degrees Cent. (2552 degrees Fahr.).

About 225 pounds of coal and a similar amount of lime are used. Iron should be melted at high voltage but after, the operations should be done on low voltage using about 3000 amperes per phase. Time for the whole operation is about 4 hours and current consumption is approximately 450 killowatt-hours per ton.

In the duplex method, the electric furnace is used in conjunction with the cupola. The best method is to have the cupola and the electric furnace located side by side with the spout of the cupola connecting with a runner to the electric furnace. The metal is tapped directly into the electric furnace where it is superheated. Adjustments include the addition of steel scrap and ferroalloys. The iron is refined, raised to temperature and tapped.

Power consumption for an output of 6 or 7 tons per hour averages about 100 kilowatt hours per ton. Comparisons of analyses before and after treatment in the electric furnace show that the carbon is lowered, silicon raised, manganese raised, sulphur and phosphorus lowered. Comparative tests of electric furnace and cupola melted irons show the following properties: Electric furnace, transverse strength, 4740 pounds per square inch; deflection in inches, 0.135; tensile in tons per square inch, 27.9; and elongation in 2 inches, 1.10; cupola, transverse strength 2950; deflection, 0.10; tensile 19.7; and elongation, 0.75.

Elements Affect Cast Iron Growth

The Influence of Phosphorus, Sulphur, Nickel and Chromium on the Growth of Cast Iron (Der Einfluss von Phosphor, Schwefel, Nickel und Chrom auf das Wachsen des Gusseisens), by O. Bauer and K. Sipp, *Die Giesserei*, Dusseldorf, Germany, Oct. 10, 1930.

Investigations were carried out on cast irons containing approximately 3.2 per cent carbon; 1.3 per cent silicon, and 0.6 per cent manganese with 0.2, 0.5, 1.0 and 1.5 per cent phosphorus, and sulphur contents of 0.10 0.15, 0.20 and 0.30 per cent which gave five different ranges. The nickel-chromium alloy irons contained about 3.2 per cent carbon; 0.6 per cent manganese; 0.2 per cent phosphorus and 0.05 per cent sulphur with silicon contents of 0.5, 1.0 and 1.5 per cent. Nickel additions of 0.5, 1.0 and 1.5 per cent were made as were 0.3, 0.6 and 0.9 per cent additions of chromium. The temperature ranges and time of duration were 80 hours at 842 degrees, and 40 hours at 1200 degrees and 1560 degrees Fahr.

It was found in the primary growth process that phosphorus, operating similar to silicon, favors the splitting up of carbides at temperatures below the pearlite point and at high temperatures favors the separation of carbon from the solid solution (austenite). Similarly with increasing graphite separation the hard phosphide disappears for with the free ferrite, it forms a solid solution up to 1.75 per cent phosphorus. No important influence of high sulphur content on the decomposition of carbides was found either in the annealing or structure of the specimens. A higher sulphur content appears to act adversely on carbide decomposition, that is to say, the separation of carbon from the solid solution. Nickel favors the separation of carbon, and thereby the growth of cast iron. Nickel especially reinforces the action of silicon. Chromium acts similarly to manganese in rendering carbide decomposition difficult, and consequently hinders growth of the iron.

The FOUNDRY Family Photograph Album

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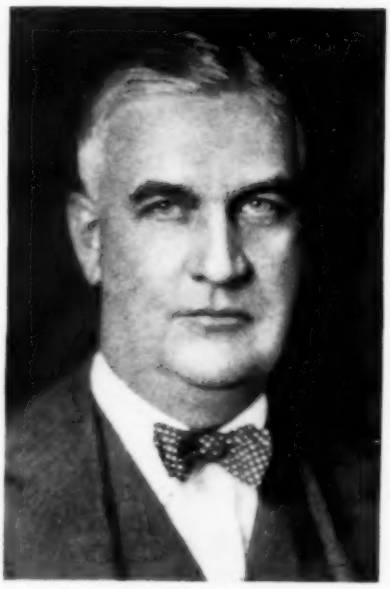

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Upper Left

J. L. ANTHONY

Glenwood Range Co., Taunton, Mass.

Upper Right

J. R. PATTERSON

Mackintosh - Hemphill Co., Pittsburgh

Lower Left

J. G. GARRARD

Grand Rapids Malleable Works, Grand Rapids, Mich.

Lower Right

R. E. MOLLEY

American Boron Products Co., Buffalo

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NONFERROUS MATERIALS OF CONSTRUCTION

In Aircraft Engines

(*Continued from Data Sheet No.* 840)

On small engines, rating 100 horsepower or less, connecting rods are sometimes made from aluminum alloy forgings. The alloys generally used are alloys *M* or *N* which are heat treated to produce the physical properties shown in Table I. It has not been found practical to employ aluminum-alloy connecting rods on large engines.

Intake pipes on radial engines are made from aluminum tubing. Cowling is made from aluminum sheet. These parts are unimportant structurally; the only precaution to be observed is that the sheets or tubes are of the proper temper to permit forming without rupture, as required from the design of these parts.

Brass and bronze make up a small portion by weight of the metals used in aircraft engine construction. They are heavy alloys and for that reason are avoided when possible. At present, however, certain special parts such as bearings and certain gears are best made of bronze. The uses of brass and bronze for structural parts and miscellaneous fittings are due to special features of these alloys. In Table II is given a list of alloys and their chemical compositions and physical properties.

Gives Bearing Compositions

A large number of bearing bushings are made from alloys Nos. 1 and 3. An excellent bearing capable of withstanding considerable loading and offering good bearing qualities is made from alloy No. 5. For bearings which have to operate under poor lubricating conditions the high-lead bronze alloy No. 4 is good. For spiral or worm gears phosphor bronze alloy No. 2 or the nickel-bearing bronze alloy No. 5 have been successful. The characteristics of alloys Nos. 2 and 5 are improved greatly by chilling which refines the grain and increases the hardness considerably.

For parts of complicated shape which are, therefore, required to be cast, either of the alloys Nos. 6, 7, 8, 9 or 10 are used, depending upon the requirements. The red and yellow brass alloys Nos. 6 and 7 fulfill the requirements for the cheaper brass of low strength and are easily machined. These alloys are used for unimportant parts such as plugs, fittings, caps, etc. When a higher strength alloy is required the manganese bronze alloy No. 8 or aluminum bronze alloy No. 10 are used. The aluminum bronze has a better resistance to impact and excellent fatigue resisting properties. It has been used successfully on spiral and worm gears. Alloy No. 11 is an aluminum bronze of higher iron content and added nickel and it responds well to heat

(*Concluded on Data Sheet No.* 842)

NONFERROUS MATERIALS OF CONSTRUCTION

In Aircraft Engines

(*Concluded from Data Sheet No.* 841)

treatment. When a high strength bronze is desired alloy No. 9 is used. This alloy also responds to heat treatment and will harden to a Brinell hardness of about 200 or 225.

Alloy No. 12 is used for parts of simple design that can be made on the screw machine and do not require any great strength. When greater strength is required an aluminum bronze alloy No. 13 or the copper-silico-manganese alloy No. 14 can be used.

Table II.—Brass and Bronze.

Alloy	Name	Chemical Composition									Yield Point, lb. per sq. in.	Tensile Strength, lb. per sq. in.	Elongation in 2 in., per cent	S.A.E. Designation
		Copper, per cent	Tin, per cent	Zinc, per cent	Lead, per cent	Phosphorus, per cent	Nickel, per cent	Manganese, per cent	Iron, per cent	Aluminum, per cent	Silicon, per cent				
No. 1	Cast Bronze	88	10	2	..	....	....	....	....	....	....	18 000 to 20 000	30 000 to 45 000	15 to 25	No. 62
No. 2	Phosphor Bronze	89	11	....	....	0.25	....	....	....	....	....	20 000 to 23 000	30 000 to 40 000	10 to 15	No. 65
No. 3	Bearing Bronze	80	10	....	10	0.25	....	....	....	....	....	14 000	26 000	8	No. 64
No. 4	High Lead Bronze	74	5	....	21	....	....	....	....	....	....	12 000	20 000	8	....
No. 5	Nickel Bronze	83.5	10	....	3	....	3.5	....	....	....	....	25 000	38 000 to 47 000	7 to 12	....
No. 6	Red Brass	88	5	5	5	....	....	....	....	....	....	15 000 to 18 000	26 000 to 32 000	15 to 20	No. 40
No. 7	Yellow Brass	63	..	34	3	....	....	....	....	....	....	12 000	25 000	20	No. 41
No. 8	Manganese Bronze	60	..	40	....	....	....	....	....	....	....	30 000	60 000	15	No. 43
No. 9	Super Manganese Bronze	69	..	20	....	....	....	2	2.5	6.5	....	50 000 to 57 000	101 000 to 110 000	5 to 10	....
No. 10	Aluminum Bronze	90	..	....	....	....	....	....	1.0	10	....	22 000 to 26 000	60 000 to 75 000	15 to 25	....
No. 11	Special Aluminum Bronze	79	..	....	....	....	5.0	....	5.0	11	....	[a]	[a]	[a]	[a]
No. 12	Free Cutting Brass Rod	62	..	35.5	2.5	....	....	....	....	....	....	....	....	....	No. 72
No. 13	Extruded Aluminum Bronze	89	..	....	....	....	....	....	1.0	10	....	37 000	75 000	20	
No. 14	Everdur	95.5	..	....	....	....	....	1	....	....	3.5	....	....	....	

[a] Heat treated to a Brinell hardness of 200.

THE FOUNDRY DATA SHEET, DEC. 15, 1930
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Questions & Answers on FOUNDRY PRACTICE

GENERAL

Cupola Has Slag Trouble

QUESTION

We are operating a cupola lined to 30 inches with a 600-pound coke bed, 1000-pound iron charges, and 70-pound coke splits. For the past two or three months we have had trouble with slagging after 6 or 7 charges have been melted. We have tried changing the blast without success. The tuyeres are 18 inches from the bottom.

ANSWER

You do not state whether you are melting continuously, but from your description, we presume that you are. If that is the case, you should install a slaghole, which may be opened after the cupola has been in blast about an hour or just before the slag reaches the tuyeres. This stage of operations may be judged by looking in the tuyere peepholes which will show how high the slag is. The slaghole, placed opposite the taphole, is located about 4 inches below the bottom of the tuyeres. A 1-inch hole probably will be large enough at the start as the slag and escaping blast will enlarge it soon enough. The hole should be plugged with molding sand at the start, and after enough slag has accumulated, it may be opened easily with a pointed bar. After the slag has started to flow it should continue until nearly all the iron is melted and the level drops below the slaghole. Poking the hole occasionally with a rod will assist in keeping it open.

Although you state that you are melting 1000 pounds of iron with 70 pounds of coke, it seems rather low to us. Therefore, we suggest that you increase the weight to at least 100 pounds. Your weight of 600 pounds for the bed seems about right, but we believe that you should place it by measure rather than by weight. Use a rod that will reach from the charging door to within 30 inches of the top of the upper edge of the tuyeres. Put enough coke on your bed so that it just touches the rod when leveled off. Always keep it at this point whether it takes 500 or 700 pounds of coke.

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall
Cast Steel

H. A. Schwartz
Malleable Cast Iron

J. W. Bolton
Gray Cast Iron

All questions should be addressed to the Editor, The Foundry, Penton Building, Cleveland.

Q & A

Sand Sticks To Boxes

QUESTION

We are using cast iron and aluminum multiple core boxes in which one half of the box is used as the dryer. We use straight linseed oil as the binder and the oil and sand burn and accumulate on the dryer half of the box. Can you tell us how best to remove this deposit from boxes?

ANSWER

Probably the best way to remove the deposit is to use the sandblast. This will cut the deposit away nicely, and if carefully done only a slight amount of metal will be removed. Possibly soaking the dryers in a strong alkaline cleaning solution will soften up the deposit so that it may be scraped out. However, be careful with the aluminum boxes as aluminum is attacked by alkalies. We believe that you can remedy this trouble by watching the amount of oil used in your cores. You should not use any more than is necessary to give the required strength. If you employ only this amount, the oil will be held in the intertices between the sand grains and will not get on the core dryer except to a limited extent. Therefore, it will pay you to check the amount of oil used. You will save in oil and eliminate to a large extent, your difficulty with core dryers.

Q & A

Iron Backs Out of Mold

QUESTION

We make a semisteel ammonia cylinder weighing about 600 pounds, poured through pop gates on the neck and with a riser on top of the big end. About 30 seconds after the mold has been filled, the metal comes up in the riser, cracks the film and oozes through slowly. We make these castings regularly and seldom lose one, but I should like to know what is the cause of this peculiar behavior.

ANSWER

The point you raise about the iron backing out of the riser is rather out of the ordinary and we should like either to make a personal examination, or to learn many additional particulars connected with the metal, the mold and the core before submitting a positive opinion. The most probable cause is that the metal is slightly oxidized, which in plain foundry language means that it is holding a certain amount of gas in solution. When the metal starts to freeze in the mold, this gas is squeezed out. The casting develops a skin all over in contact with the face of the mold, and the only avenue of escape for the gas is through the still liquid riser. Naturally, it pushes some of the metal

ahead of it. This phenomenom is common in castings made from any metal that is oxidized. Brass and steel show it to a greater extent than gray iron. The steel in your mixture, also your (probable) low phosphorus content, renders your metal more susceptible than ordinary gray iron to oxidation. The only flaw in this theory is that your castings are perfect, while they really should show leaky areas when tested. You do not state if any other castings are affected in a similar manner. If this cylinder alone develops this peculiarity, then the foregoing theory must be wrong and the cause must be sought elsewhere, probably in the core. The following opinion was submitted in reply to a somewhat similar query some time ago. Under the heading *Reader's Comment*, R. H. West, West Steel Casting Co., Cleveland, wrote:

"I am inclined to the opinion that the trouble is with the metal. The foundryman should examine his iron thoroughly for signs of oxidation. To test out this theory, he might use an extra amount either of fine ferromanganese or some aluminum alloy as a deoxidizer. With exceedingly hot metal this material may be added to the metal in the ladle while the stream is running from the spout of the cupola. Under other conditions, the material may be charged in lump form directly into the cupola with the pig iron and scrap. Lump spiegel added to each charge would supply a good practical solution to the problem. The trouble also may be caused by skimping on the limestone to an extent the cupola is not fluxed properly."

Q & A

Pour Castings Rapidly

QUESTION

We are experiencing trouble in securing a clean, smooth face on a shovel die casting which is chilled on the working face. Can you give us a remedy?

ANSWER

Warm the chill, cover it with a light coating of oil and plumbago, pour the mold rapidly with hot iron and the casting will present a clean, smooth face. A damp, cold chill will cause the iron to *kick* away from contact. The kicking or boiling process creates scum and slag. It also produces wrinkles and pitted areas in the face of the casting. Dull iron, or iron that is poured slowly, rises in the mold in a succession of steps and each step shows on the face of the casting as a wrinkle in the skin. Contact with the chill produces a skin or thin film on the molten iron which causes the iron to hesitate momentarily at a succession of levels in the mold. This property is possessed by practically all liquids and is known as surface tension. It is most noticeable in mercury, which, as you probably know, will roll around on a flat surface instead of spreading out flat. You probably also have noticed evidence of this property in iron poured into open sand plates. If you continue to pour metal into the mold it will rise from ⅛ to ¼-inch above the surrounding sand before it flows over. Your problem in securing a clean face on the chilled shovel die casting is to provide a warm dry mold that will not cause the iron to boil, and then pour the iron at a speed that will prevent it from lingering at any level for even a fraction of a second. It must be kept in constant motion.

GRAY IRON

Mold Life Increased

QUESTION

A manufacturer of high silicon pig iron has asked us to make a quantity of gray iron pig molds. Some years ago gray iron molds were used, but their life was too short. Can you suggest a suitable analysis or two for the molds which weigh 200 pounds and have 1½-inch walls?

ANSWER

Pig molds must withstand quite severe service conditions. Molten pig iron is poured into comparatively cool molds, conveyed some distance and the pigs dumped out. Water is sprayed on the pigs and molds to cause quicker cooling. That alternate heating and cooling of the molds promotes warping and cracking. In some grades of gray iron, it also may cause growth. We suggest you try molds made from the following composition: Silicon, 1.00 to 1.25 per cent; total carbon, 3.00 to 3.25 per cent; manganese, 0.50 to 0.80 per cent; sulphur, 0.08 to 0.15 per cent; phosphorus, 0.20 to 0.40 per cent, and chromium, 0.50 to 0.74 per cent.

The iron will have a white fracture, but its low carbon, low silicon, and chromium content undoubtedly will increase the life of the molds considerably above that of an ordinary 2.0 per cent silicon, 3.70 per cent carbon cupola gray iron.

Q & A

Vanadium Is Used

QUESTION

We have an order for a special casting calling for additions of a proprietary alloy and vanadium. Will you give me the composition of the alloy and its effect on gray iron, and also the effect of vanadium and the amount to be used:

ANSWER

The alloy mentioned is an alloy steel and has several compositions. Some of the steels contain only chromium as the alloying material and others contain both chromium and nickel. One of the chromium alloys contains from 27 to 30 per cent chromium and the other 16 to 18 per cent chromium. The alloys containing chromium and nickel show the following compositions: 21 to 24 per cent chromium and 12 per cent nickel; 18 per cent chromium and 8 per cent nickel; and 15 per cent chromium and 35 per cent nickel.

Chromium exerts a powerful influence in preventing the formation of graphite. In a cast iron containing 1 per cent silicon according to Hurst, the addition of 0.90 per cent chromium produced a quite mottled fracture, and 4 per cent chromium added to an iron containing 1.5 per cent silicon made the fracture perfectly white. The specimens used were 1-inch square and 12 inches long. With heavier sections the effect may not be so pronounced. Nickel promotes dissociation of the carbide with consequent production of graphite. In other words nickel will modify the effect of chromium.

Vanadium is said to increase the tensile, transverse and compressive strengths of cast iron. It exercises a strong influence on the grain causing a more uniform distribution of graphite and freedom from porosity. The amount employed is in the range of 0.15 per cent.

Q & A

Iron Melts Continuously

QUESTION

I require a small quantity of molten gray iron daily to pour castings from 5/64 to ⅛-inch thick and weighing from ¾ to 4 pounds. They must be easily machined. I wish to operate continuously using at the rate of 675 to 800 pounds of metal per hour from 8 a.m. to 5:30 p.m. except for a break at noon. What will be the best way of melting? Can a small cupola be used, or will it be better to melt the metal all at once and hold it in a separately heated receiver?

ANSWER

Wherever the cupola may be applied, it generally is found the most satisfactory and economical melting unit for gray iron. However, cupolas melting 675 to 800 pounds per hour are small in diameter and in some respects more difficult to handle than the medium or larger sizes. To melt 800 pounds an hour, the cupola would be about 16 to 18 inches in diameter inside. The stock charged would have to be broken up into small pieces or there will be serious danger of bridging. It is hard to slag such a small cupola successfully, and without slagging the cupola undoubtedly would bridge badly in an 8-hour run. Air and coke ratios will need careful adjustment. Therefore, use of a cupola of the size mentioned would be practical only in the hands of an experienced operator.

Also it is believed that it would be

better to use a small cupola than to use a large cupola and a receiver. It is hard to keep small amounts of iron at superheat without an expensive and somewhat clumsy installation. Small, soft castings necessitate clean, hot iron and a 5/64-inch section is quite light. Oil or gas-fired receivers sometimes cause the loss of silicon and carbon which may be detrimental.

Undoubtedly, a small electric furnace would solve your problem. Commercial sized furnaces may be obtained ranging from 250 pounds upward per hour. Usually, the furnaces will hold charges larger than the rated capacity. An electric furnace will supply hot, clean metal when operated properly. Some foundries employ an oil fired open flame furnace for melting gray iron and obtain excellent results. Manufacturers of both types of furnaces who advertise in THE FOUNDRY will supply information on applications of those furnaces in melting gray iron.

Q & A

Casting Fed Improperly

QUESTION

We are forwarding a cast iron pulley, 12 inches in diameter with a 2½-inch face. You will notice two depressions on the inside of the cored hub. These depressions are the cope side and are on either side of the point where the sprue is attached. Can you tell us what causes the depression?

ANSWER

The depression on the interior of the hub of the pulley are shrinkage cavities caused by improper feeding. This lack of feeding may be due to the casting being poured short, or to the fact that the cope it not high enough to supply the requisite head of metal. Undoubtedly, the metal is poured into a small basin which leads to the sprue, and the arrangement of the basin may be the cause of the trouble. If the basin is made by scooping out some of the sand in the cope, the effective metal head is reduced by that much. Therefore, if such is the practice, we suggest that the basin be built on the top of the cope. You also can increase the head of metal by building the basin several inches higher than the cope.

MALLEABLE

Shrink Bob Is in Cope

QUESTION

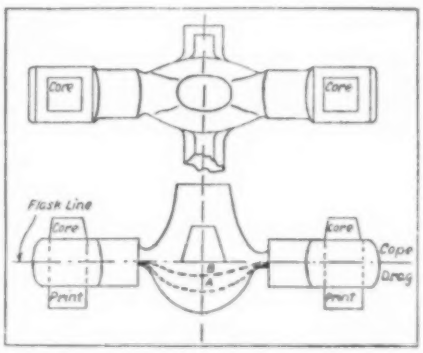
In a recent article in THE FOUNDRY on malleable iron founding I noticed some illustrations which showed shrink bobs or blind risers in the drag. I would like to know why the cope cavity for the risers were not made larger and that in the drag eliminated. If half of the riser is in the drag will not dirty castings result?

ANSWER

While the illustrations may appear to show half of the blind riser in the drag and half in the cope, the actual truth of the matter is that only a slight heel is in the drag. In other words the cavity in the drag is probably about ½-inch deep, feathering off to nothing near the casting cavity. The real reservoir of metal is in the cavity in the cope which is about 3 inches deep.

The portion of the blind riser in the drag half of the mold is to increase the body of metal slightly at that point where the choked branch gate leads to the casting cavity. Also the cooler metal entering the riser is held back slightly so that the hotter metal enters the casting cavity.

There is no reason why a casting should be dirty if part of the riser is in the drag providing the sand is in proper condition. If the sand is weak in bond, too dry, or too wet, you will have trouble due to the sand washing before the incoming metal or to boiling which loosens the sand. In the accompanying illustration, the portion of the riser below the parting line is exaggerated. There is no need for it to extend below the dotted line shown at *A*, and we believe that satisfactory results may be obtained with the riser no deeper than *B*.



Dotted Lines Show Limit of Depth of Riser

STEEL

Steel Is Stainless

QUESTION

Can you give us any information on stainless steel castings? Also we would like to know whether those alloys can be handled successfully in a brass foundry.

ANSWER

Stainless steel castings are of several types. The first generally contains from 12 to 18 per cent chromium with carbon below 0.25 to 0.30 per cent, and sometimes below 0.10 per cent. When heat treated by quenching from a high temperature and properly polished, these castings are more or less proof against rusting and against attack of certain acids.

Another type which is nearer rust proof and has a wider range of resistance to acid attack, contains in addition to the chromium a considerable proportion of nickel. Steels of that type are made with chromium ranging from 16 to as high as 30 per cent, and nickel from 8 to 20 per cent. They commonly are desired with low carbon, many types being made with carbon not over 0.10 per cent. A number of steels in this class are resistant to scaling when raised to a red heat. Other alloys, such as tungsten, molybdenum, etc., sometimes are added to steels of this class to modify their properties for particular applications, or to increase their resistance to certain types of corrosive agents. All these steels are heat treated, and in many instances they are polished to make them properly resistant to rusting or corrosion.

For resisting scaling at high temperatures, alloys are made containing even higher proportions of chromium and nickel than those just described. Such alloys are used chiefly for parts of furnaces and equipment which are subjected continuously to high temperatures.

The metals for castings of these different alloys are in practically all cases made in the electric furnace. The refractory lining of the furnace has to be of the highest grade material used in steel foundry practice, as the temperatures to which the metal is heated are high. A great deal of difficulty is experienced by all manufacturers in producing steels in the lower ranges of carbon. This is of great importance as the higher carbon alloys are far more difficult to machine, and are less resistant to corrosion and rusting than those in which the carbon is kept low. The latter usually means that ferrochromium, extremely low in carbon, is employed in making these alloy steels.

The materials used in molding generally are the same as those used in steel foundry practice, but much more difficulty is encountered in making stainless steel castings free from pinholes and porous spots than is the case in the manufacture of ordinary carbon steel castings. To produce the smooth surface required in many of these castings so that grinding and polishing costs are reduced without sacrificing the free venting properties of the sand, is a problem which has taxed the ingenuity of steel foundrymen. Generally, a facing sand much finer than that used ordinarily in steel foundry practice is employed to provide a smoother surface on the casting.

In general a brass foundry would not have the equipment, the furnace refractories, the molding materials, the organization, nor the experience to undertake successfully the manufacture of stainless steel castings. We would say that a brass foundry only would be successful in the manufacture of such castings if it placed the work in an entirely separate department with its own melting furnace and its own organization. The organization will have to be familiar with alloy steel making.

Problems in Nonferrous Founding

By Charles Vickers

Temperature Is Low

In making bushings, two of which we are sending, we find that trouble results due to black specks. When we get away from the specks there are holes to replace them. These holes are always on the drag side, and at no particular spot in the drag. Of the two bushings we send you, the smaller one is made of 88-10-2 *alloy. The metal was melted in an oil-fired crucible furnace, and we covered the metal with glass using a broken quart milk bottle to each* 100 *pounds of metal. The melting time in this case was* 45 *minutes.*

We used 2 *per cent of cleansing alloy, and deoxidized with* 2 *ounces of phosphor copper per* 100 *pounds of metal. The latter is introduced after the pot was taken from the fire. The bushing was molded horizontally and was gated on one end, and choked in the gate. The flask was poured horizontally and rammed in No.* 0 *sand. The core was made to the following formula:* 100 *quarts sharp bank sand;* 2 *quarts flour;* 1½ *quarts of core oil. The core was extruded by machine. The alloy was poured at* 1950 *to* 2000 *degrees Fahr. We have had this happen to other bushings and the places looked the same on the outside.*

The larger of the two sample bushings is made from 80-10-10 *copper-tin-lead alloy but previous to this trouble we made them of* 88-10-2 *copper-tin-zinc alloy. When we used the latter alloy the castings were porous and had black specks in them. When there were no specks there were holes; and these latter were always on the drag side. We changed to* 80-10-10 *and the castings came hard on the outside. We eliminated that, but the holes still remain. We have changed from oil to coal using a forced draft furnace. The draft is made by running an air line into the stack and we pull down* 5 *heats in* 8 *hours using a No.* 50 *crucible with hard coal as fuel.*

We have tried making these bushings on end, in dry sand, and have used different core mixtures, different core sands, different molding sands, and have skin dried the molds. The particular casting sent you was poured at 1900 *degrees Fahr., and was gated on each end at the parting line, with a runner going full length of the casting and gates at either end of the casting. The core mixture was* 160 *quarts of burnt core sand,* 80 *quarts of new sand;* 3 *quarts of flour and one quart of rosin, wet down with glutrin water in the proportions of* 6 *parts water to* 1 *part glutrin. We keep the metal in the coal furnace covered with charcoal.*

The blemishes on the outside of the castings are caused by stiff metal that enters with the stream because it forms a coating around the same due to the metal being poured too cool. The pouring temperature of 88-10-2 alloy is from 2012 to 2192 degrees Fahr., according to the weight of the casting, and neither of these bushings should be poured under 2100 degrees Fahr. Bushings weighing over 2000 pounds are poured at about 2050 Fahr., so the temperature given is entirely too low. Get the metal hot in the furnace, bring it to 2250 degrees Fahr., and so give the gases a chance to free themselves.

In certain types of melting furnaces if the metal is not brought to 2500 degrees Fahr., and allowed time to cool and become quiet a few minutes before cooling with solid metal, the castings will be spongy. The blemish on the outsides of castings has no connection with the black specks. Hot metal will prevent it, and the formation of the holes that seem to succeed the black specks. Liquidity of the hot metal permits the escape of the gases dissolved in the metal. The amount of phosphorus can be increased to 4 ounces per hundred pounds metal in the case of the 80-10-10 alloy, but for the 88-10-2 alloy it is high enough, and might with advantage be dropped ½ ounce per hundred pounds. When melting fast, be careful to avoid too thick a blanket of glass or other flux on the metal. A blanket ⅛-inch thick is ample, otherwise porous castings may result.

For castings of the size sent as samples, a No. 0 molding sand is too fine. Nothing under a No. 1 is safe for such castings. If the gas and steam developed cannot escape as the metal replaces them, they will enter the metal with disastrous results. Let the mold be such that the gases are pushed out of the way easily by the advancing and rising metal, as the least resistance the latter encounters, the better. Use an open sand for the molds, and vent the cores so the gases can travel rapidly from the burning surfaces into the large central vent in the case of the larger casting. Another matter that is important in the case of bushings of large diameter cast horizontally is to carry the sprue up high enough to give the necessary pressure to the flowing metal. Carry it up at least 4 inches higher than the highest point of the casting.

The black specks are caused by iron sulphide, according to chemical and microscopic examinations. In 80 per cent of the cases where iron sulphide particles are found, they will be found in the drag, lodged under the core, with a great preference for places near the gates, because they do not travel far when in the mold. The best way of dealing with this material is to bring the metal to a good temperature in the furnace, and use a flux composed of soda ash. In skimming thicken the flux with sharp sand and stir well before skimming. Black specks on the outside of the casting give no reaction with acids and are therefore produced by grains of sand, washed from mold or core.

Aluminum Is Stained

We melt from 600 *to* 900 *pounds of old crank case aluminum daily. On a great many of the castings we make there appears a stain of a bronze color which is only a surface discoloration. When we polish the castings or brush them, this stain disappears, but a good many of our castings are not finished in any way and this stain is objectionable. We use a flux of our own manufacture which is satisfactory in every respect except the removal of this stain.*

The stain can be washed off the castings with a dilute solution of nitric acid. The exact strength of this solution is not a matter of record, but we believe that by using a 10 per cent solution, the stain would disappear. Add the acid to the water, and not the water to the acid. It can be applied to the stained surface by means of a swab tied to a suitable stick, and after the stain has been removed, rinse the castings off in water and let them dry. If the 10 per cent solution is found to be too weak, add more acid. Small castings can be dipped into the acid which should be kept in a crock of suitable capacity. Nitric acid solutions are corrosive and should not be allowed to come in contact with the skin or clothing.

Fundamentals of

FOUNDRY PRACTICE

Different Types of Iron Pouring Ladles Are Used Cold Metal Cause of Blowholes in Iron Castings

By Ivan Lamoureux

Interpreted in the Light of American Practice by Pat Dwyer

Part XXIV

IN SMALL foundries the sand often is removed from the surface of the castings with a wire brush. However, even in small foundries tumbling barrels are used and sand-blasting is coming into more general use. Castings to be machined are freed of all sand and scale thus decreasing the wear on the tools and increasing the output of the shop.

For large work the castings are placed on cars or on perforated bases on the inside of special rooms. The sand is mixed with the compressed air in a special device made for the purpose from which it comes with great force and speed through a nozzle attached to a rubber hose. The workman is protected with a mask and directs the stream of sand or metal abrasive against the face of the casting. Small castings are placed on a bench under a cover and the worker stands on the outside. In other instances a rotary drum is used which revolves slowly and subjects all parts of the castings to a steady sand stream. In another type, a large circular plate revolves in such a manner that one half is enclosed in a housing where the castings are subjected to a sand-blast. The other half of the disk is on the outside where a man removes the finished pieces and loads the table or plate with more to be cleaned.

Another highly popular method is to place the castings in a tumbling barrel where they rub against each other and become cleaned. Not only is the sand removed, but also the greater part of the fins are removed by the sliding and rubbing of the castings against each other. All the residue left in the tumbling barrel, such as risers, gates, fins, remains from the ladles from rabbling and screening, are dumped into a screen or under a magnetic separator and all the metal particles are recovered.

Portable pneumatic or electric grinders are used for trimming large castings. Small castings are ground on ordinary grinding wheels mounted singly or in pairs. In some foundries castings are cleaned by applying solutions of sulphuric or hydrofluoric acid either by dipping the castings in a bath or by spilling the acid over the surface.

Clean the Castings

THIS, the twenty-fourth and concluding chapter in the manual of foundry practice prepared by Ivan Lamoureux, Liege, Belgium, is devoted to a brief discussion of cleaning, machine molding and repair methods. The author also develops a brief description of the ordinary defects found in iron castings, their causes and methods of prevention. The first installment of this series appeared in the Jan. 1, 1930 *issue, and the remaining sections were published consecutively in succeeding issues.*

A comprehensive series of 16 articles which commenced with the Feb. 15, and closed with the Dec. 1, 1928 issues of THE FOUNDRY, under the title "Cleaning Room Progress Aids Production of Quality Castings" covers this phase of foundry practice in every detail of equipment and methods.

Hundreds of types of molding machines are on the market and a description of their particular features would fill a good sized volume. As each molding operation has been explained in former sections of this course, a slightly detailed account of the machines is all that is required here. In machine molding practice the sand is rammed according to one of the following methods: Hand ramming with plain or pneumatic rammer; hand squeezing; power squeezing; jolt ramming, and sand throwing. In hand ramming, the pattern plate may be attached to the machine or free on dowel pins. The sand is rammed as in ordinary floor practice by a rammer manipulated by hand, or, by a rammer actuated by compressed air.

A set of suitable levers, connecting rods, eccentrics, racks, etc., multiply the force exerted on the end of the operating lever where a hand squeezing machine is employed to pack the sand. The same effect is secured in a power operated machine where the squeezing head is actuated by a piston or arm driven by a crank, compressed air or hydraulic pressure. In certain types of jolt ramming machines the flask and the sand are placed over a piston. They receive upward jolts which cause the sand to pack. These machines are operated mechanically by a cam which raises the table attached to a piston and then allows it to drop. In the more familiar types the piston is raised by compressed air; at a predetermined point the air is allowed to escape and the piston, table and flask drop by gravity on an anvil. In one type of sand throwing machine, the stream of sand impinges on a rapidly revolving paddle and is driven into the flask with sufficient force to pack it to any required density. In a second type of somewhat similar machine the sand is drievn through a hose into the flask with compressed air. The first machine is of American invention. The second was developed in Germany.

Usually the flask, especially the cope flask is raised from the pattern by suitable plunges or adjustable rods. On a properly vertical draw a cope can be lifted without any drop outs. Sometimes the flask remains on the table of the machine and the pattern is drawn downward. Where the patterns are quite high or the walls are quite straight, a condition which may cause the sand to drop off, a stripping plate is used. This is a sort of frame which holds the sand in the flask on the outside of the pattern and prevents it from dropping off. On the inside of the pattern recourse is had to a modifi-

cation of the same device which lifts up the small cakes of sand which otherwise would drop out on drawing the pattern. Usually the pattern is drawn from the drag after it has been turned over. In one type of machine, the pattern is drawn straight up out of the mold. In a second type the rolling movement is halted temporarily at the highest point in the arc, a table is raised to receive and support the drag mold. The clamps are released and the table sinks back to place taking the drag with it. The pattern and pattern plate remain stationary until the drag is removed. Then they are swung back into place for the following mold and the process is repeated.

Some machines are designed to make a complete mold, that is the two halves of the mold are formed simultaneously. Molding machines perform one or the other of the various operations indicated or they do them all. Thus we have plain squeeze machines, plain jolt machines, combination squeeze and jolt machines, roll over machines that employ either the squeeze or jolt principle, or both. Other machines in addition are equipped for drawing the pattern.

Autogenuous, oxyacetylene, oxihydric and electric welding to a great extent have taken the place of the burning on process with molten metal, at one time the foundryman's only remedy.

Some really remarkable jobs have been credited to the burning on process. Skilled foundrymen have repaired propeller blades, rolls, and roll housings, shear frames, etc. The cost of the operation is insignificant and the results in many instances are good. An essential condition is that the casting is heated before, and cooled slowly and uniformly after the operation. Usually this style of repair is regarded as an emergency measure when the time element involved is the most important factor.

Show Various Defects

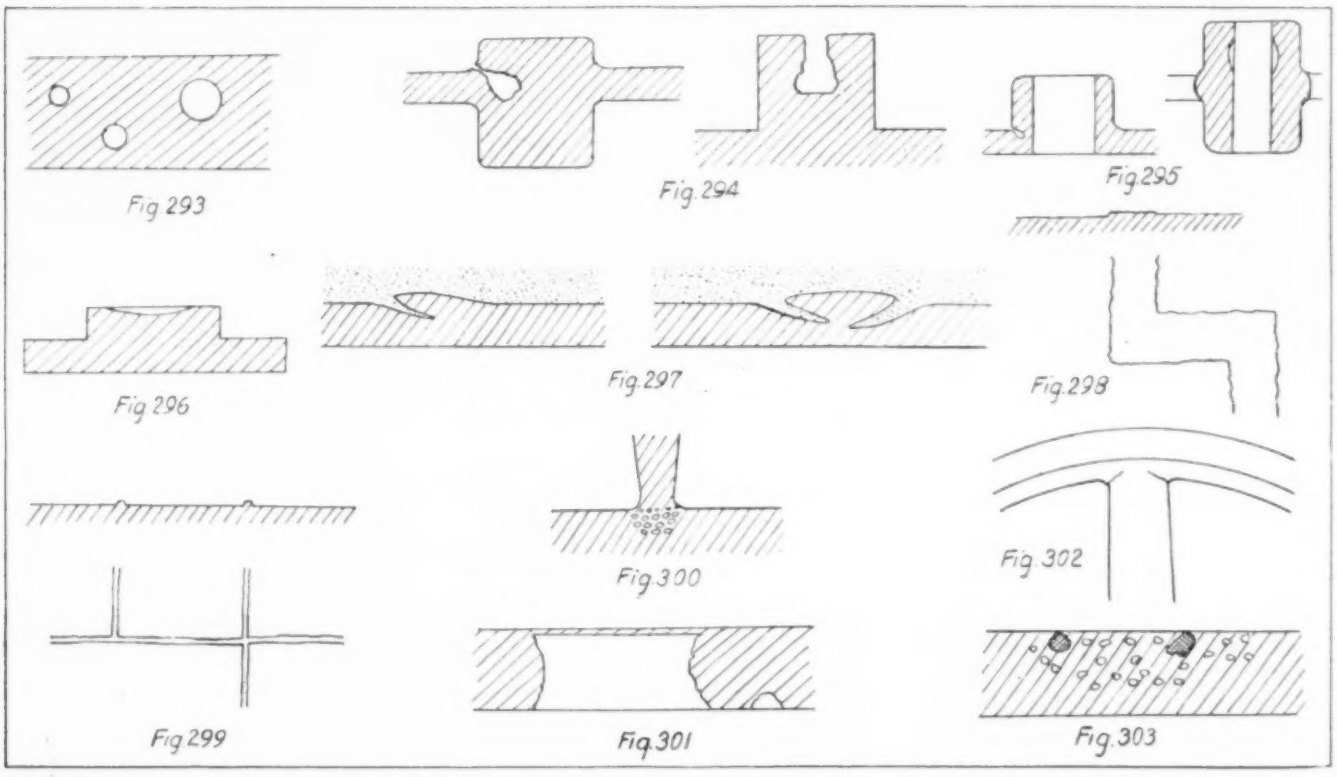
Cavities shown in Fig. 293 that are not apparent before machining of the casting are known as blowholes. They are the result of a lack of fluidity due to a too low temperature of the iron, or its composition. Iron that has been remelted several times and lacks the proper amount of carbon and silicon will show these defects.

Pipes, as illustrated in Fig. 294, are hollow or spongy portions of a casting having irregular or thick sections, usually the result of hard ramming and shrinkage. Natural settling of the upper side of a cast block, due to contraction and shrinkage is shown in Fig. 296. Like shrinkage, settling is not a defect. It is the difference between the dimensions of the mold and those of the casting.

Scabs may be the result of various causes including: (a) washing away of the mold by a violent rush of metal between the walls; (b) wrong position of the gates; (c) sand too moist, rammed too hard, badly patched; (d) sand of poor quality. Scurf or scruff is the superficial defect resulting from the washing away of the sand or of the blacking, Fig. 298. The worms appear on the surface as threads, Fig. 299.

Spongy iron, Fig. 300, usually is found in top flanges or near shrink heads. When a shrink head is pumped or churned too long, the fracture shows a metal without any homogenity. Hence it is said the metal is rotten. Where a mold, particularly the cope face, is too hard or where the gas and air are prevented from escaping readily, cavities similar to those in Fig. 301 are produced, covered with a thin layer of iron.

Failures and ruptures are due to wrong proportion of thicknesses, bad shape of the casting, wrong way of pouring. Pouring through the rim of a pulley often will prevent breaking of the spokes, Fig. 302. Small masses of iron about the size of a pea, and sometimes the size of a walnut, extremely hard are known as diamonds, Fig. 303. They have to be removed from the metal before machining can be continued. Usually they result from some concentrations of phosphorus and sulphur due to irregular pouring. Under certain conditions they may be traced to the shape and position of the gate. Where the first iron strikes the bottom of a hard gate it will spatter into a number of shilled drops or pellets.



Various Types of Casting Defects. Fig. 293—Blowholes. Figs. 294 and 295—Pipes. Fig. 296—Shrinkage. Fig. 297—Scabs or Buckles. Figs. 298 and 299—Washed or Wormy Surface. Fig. 300—Rotten Metal Under a Riser. Fig. 301—Blister. Fig. 302—Cracked Arm. Fig. 303—Diamonds or Hard Particles in the Metal

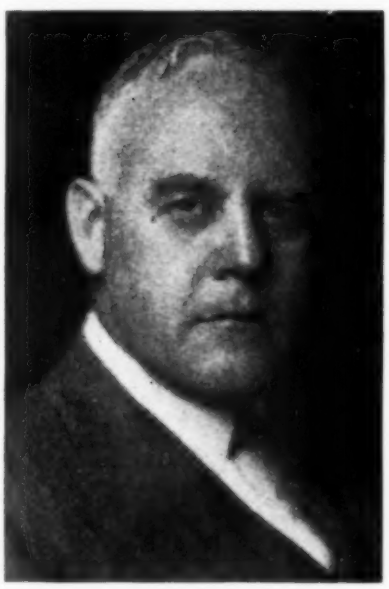
THE LABORATORY

Races Ahead of Industry

Professor McCaffery Stresses Need for Greater Technical Leadership at National Founders Meeting—S. Wells Utley Is Made President

NEED for greater research and technical leadership in the foundry industry was stressed by Richard S. McCaffery, professor of metallurgy, University of Wisconsin, Madison, Wis., at the thirty-fourth annual convention of the National Founders association, held at the Hotel Astor, New York, Nov. 19-20.

Industry is years behind the laboratory in metallurgical practice and needs men to develop research, he said. Due to conditions imposed by



S. Wells Utley

a highly specialized industry, men in the industry have not had a sufficient all-around training to enable them to even keep abreast with current developments. The speaker recommended greater consideration of methods of training men.

The subject of training along with other personnel problems dominated the discussions, although such subjects as cost accounting and foundry practice were given careful consideration. Approximately 190 were registered, a slight gain over a year ago.

With little hope for an early revival in business, members passed a resolution, calling upon all to do everything possible in providing for as wide a distribution of work as possible. That this already is being done in good measure, however, was indicated by Thomas S. Hammond, Whiting Corp., Harvey, Ill., retiring president, when he pointed out that never before in the history of the foundry industry has the unemployment problem received such efficient handling.

"Instead of the wholesale laying off of employes as in the old days," he said, "there has been an intelligent division of work. Thrift plans, insurance plans, education of the employe so that he may better plan for his future, has given him still further protection. To the extent we anticipate and solve these problems for ourselves, to that extent will we be free from the danger of perhaps unwise government regulation."

Officers Are Elected

Association membership, it was revealed, comprised 463 plants, a decline of 13 within the past year, of which eight permanently closed their foundry departments. In view of existing business conditions this showing was regarded as satisfactory.

S. Wells Utley, Detroit Steel Casting Co., Detroit, was elected president, and C. H. Hoffstetter, Odin Stove Mfg. Co., Erie, Pa., vice president. J. M. Taylor, Chicago, was re-elected secretary.

Edward Grant Conklin, professor of biology, Princeton university, was the principal speaker at the annual dinner. This subject was "The Human Melting Pot."

At a breakfast meeting held Thursday morning, about sixty foundrymen engaged in a round-table discussion on costs. John L. Carter, Sacks-Barlow Foundries, Inc., Newark, N. J., presided. The cost system adopted by the Gray Iron institute was introduced by the chairman and comments were made by E. T. Runge, Cleveland and Charles A. Klaus, Newark, who are actively charged with the work of administering cost matters under the institute. Granville P. Rogers, managing director, Steel Founders' Society of America, told of the new cost system adopted by that organization.

A new program of industrial education was approved by the members. This consists of a series of regional meetings to be conducted under the general direction of Dr. Harry Myers, Dayton, who gave a working demonstration of the manner in which these meetings might be conducted and who expressed his views, as an industrial engineer, as

Carl H. Hoffstetter

to attaining more efficient plant operation.

Dr. Myers stressed particularly the necessity for cleanliness and order in a plant, declaring that where these measures are taken there is little possibility of workmen being careless and slipshod in their daily work.

The speaker laid down six laws for good work: 1, be clean and orderly; 2, take good care of property, equipment and materials; 3, follow instructions carefully and continually; 4, work well from whistle to whistle; 5, work every day and tell your foreman when you cannot; and 6, work well with others in the shop.

He laid down six principles for foremanship: 1, a clean and orderly department; 2, proper equipment; 3, proper materials; 4, proper construction; 5, proper supervision; and 6, proper pay.

An interesting tie-up exists between these two groups of principles, the speaker declared. The foreman must provide a clean and orderly department, but he can never do it unless his men are clean and orderly. He must provide proper equipment and materials, but he cannot unless his men take good care of the materials.

These proposed regional meetings, it was revealed, would begin at 10 o'clock in the morning and continue on until late in the afternoon. It was suggested that where possible these meetings be held at foremen's clubs in the various cities.

Discussing the need for greater technical training, Professor McCaffery described briefly the manner in which the University of Wisconsin and the foundry industry of that state are co-operating in the matter of educational work.

Has Extension Course

Briefly, the method calls first for the further development of men with technical engineering background and then, largely with the assistance of these men, the educational development of those without this engineering background. The university has an extension course in metallurgy whereby technical graduates can obtain a masters degree. With this incentive technical school graduates in ten plants in Milwaukee alone recently completed a research program under the supervision of the university. These men met in Milwaukee every Friday night throughout a period of three years to obtain their degree.

For men who have not a technical background the university has been conducting regular meetings in Milwaukee, with the co-operation with the foundries of that city, for approximately 5 years with considerable benefit to the men. These meetings are now attended by about 80 men. In addition Professor McCaffery said, there is an annual foundry conference at Madison. This year 130 attended, of which approximately half were from outside the state. He believed great good could be accomplished by such co-operation between technical schools and industrial concerns generally throughout the country.

If the industry is to advance it must do its own research, he said. Co-operative effort is desirable among several plants, where the individual plant is not large enough to support this work and few are. At present there are probably not more than eight or ten research laboratories in the true sense in American industry, the speaker declared.

In response to questioning, Professor McCaffery said that some of the research problems conducted by foundrymen under the universities supervision were two pertaining to the heat balance of malleable furnaces, one being conducted at a plant where coal was used and the other at a plant where oil was used. The annealing cycle in malleable operation was another, while still another, he said, had to do with reactions taking place in the basic lining in steel furnaces.

"Money Savers for the Jobbing Industry" was the subject of an illustrated talk by William C. Wright, consultant for the association. He discussed the subject of undue shrinkage at length, asserting that

J. M. Taylor

this probably causes the most trouble in foundries. He emphasized the importance of uniform sections, especially where two sections come together.

Making a low phosphorus iron from a low phosphorus pig, a malleable pig and steel comes as near overcoming the trouble of undue shrinkage as anything. By low phosphorus, he meant as low as 0.16 or 0.18 per cent. He then suggested that the foundry keep the silicon as low as machining will permit. Gating has a great influence; also the pouring temperature.

Discussing sand mixtures, he asserted that synthetic sand has qualities that make it superior to natural molding sand. He was impressed by the fact that the fineness of the grain of synthetic sand can be kept constant. The speaker urged all to install labor handling equipment where possible and described various types of machines.

Robert E. Moore, vice president, Flockhart Foundry Co., Newark, described an application of gray iron to curbing. He described a process, wherein the metal is used in the conjunction with concrete. It offers unusual resistance to impact, he said, and while no efforts have as yet been made to advertise the use of this process, it already has been accepted as standard by two or three leading railroads and industrial concerns.

Discussing difficulties confronting the American farmer, Thomas D. Campbell, Hardin, Montana, urged association members to support the activities of Federal Farm board. He favored a flexible form of tariff which would afford farmers a measure of relief comparable to that enjoyed by industry. He also urged an adjustment in transportation rates, which he believed could be done without affecting the revenues of transportation companies. He expressed himself, as a farmer, as being in favor of inland water way development.

Light Metals Group Is Organized by A. S. A.

American Standards association, 29 West Thirty-ninth street, New York, has formed a light metals group with the Aluminum Co. of America, Pittsburgh, as the first member. The new group was formed to stimulate the establishment of national standards and specifications covering the processes and products of the light metals industry. Those include aluminum and magnesium and their alloys and also alloys of those metals with other metals. The new group is the forty-fifth member body of the association with representation of the A. S. A. standards council.

Drafts of the proposed standards for pipe flanges and fittings have been prepared by the A. S. A. technical committee covering cover pipe plugs of cast iron, malleable iron, cast and forged steel. Another specification covers steel base-fittings for maximum steam working pressure of 250, 400, 600, and 900 pounds per square inch and steel companion flanges. The work was done under the sponsorship of the American Society of Mechanical Engineers, Heating & Piping Contractors, National association and the Manufacturers' Standardization Society of the Valve and Fittings Industry. Drafts of the proposed specifications are available at the headquarters of the American Standards association, 29 West Thirty-ninth street, New York.

Elmer P. Grismer and L. D. Bowden have been appointed general sales manager and sales manager, automotive division, respectively, of the R. G. Haskins Co., Chicago. Mr. Bowden formerly handled general sales in the Chicago and South Bend territory.

Bill Favors Greater Number of Tuyeres

By Pat Dwyer

DOWN in the wholesale section of the city the other day, I was attracted by a gorgeous display of vases in a window. A large card announced that the goods were imported and now were on sale at the ridiculously low price of $1.95. Common sense warned me I had as much need of one of the things as I had for a live elephant, and yet I had to summon up all the reserve self control to resist the force that was trying to pull me inside the store.

The attraction was based on admiration for the superb skill of the potters who had fashioned the pieces and ornamented them so cunningly. The colors also appealed to me and I marveled at the manner in which one shade merged into another as smoothly and harmoniously as they merge in the petals of a gorgeous flower or the inside of a sea shell. Without any doubt, I said to myself, whoever is responsible for the production of these articles, must derive a great deal of pleasure from their daily work. In my mind's eye I visioned one of these skilled artificers, sitting in front of a swiftly spinning potter's wheel on which a lump of clay rapidly grows into a thing of grace and beauty, under deft and delicate fingers. The wheel is driven by a treadle on which the feet of the operator keep time to a crooning melody. The breeze rustles gently through the open window and carries the scent of rose and honeysuckle. Birds twitter joyously from the lawn and ornamental shrubs. The sparkling jet from a fountain falls in a shower of spray on the glistening blossoms and leaves of lilies in the pool. Commenting on the incident later to Bill, I found him singularly lacking in enthusiasm. "The stuff may be imported," he said. "I did not see it. Even if I was allowed to examine each of the pieces I could not decide — and neither could you—if they were of native or foreign manufacture. Also, dear lad, you must bear in mind that the term *imported* is rather elastic. In the strictest sense it usually is accepted to mean something that has been brought into the country from outside. However, usage has sanctioned the employment of the term in a much more restricted territory.

"Those marvelous vases may have been imported from Europe, Asia, Africa, Australia, South America, Canada or Mexico, but the term still might apply if they were imported into this city from Trenton, N. J., or Liverpool, in this sovereign state of Ohio. Anyway, what difference does it make where they originated? I can't see that the value of an article is enhanced by the number of miles it has to travel.

"If only one piece was on display, or if each piece was distinctly different from the others, I could understand the appeal. The average man —or woman—derives a curious sort of pleasure from the ownership of anything rare. One can understand the sentiment in connection with something of intrinsic value, for example, a large diamond, but why a person should cherish and secretly adore an object, simply because no other person has one precisely like it, always will remain a mystery to me. Also wherein does old furniture differ from old clothes?

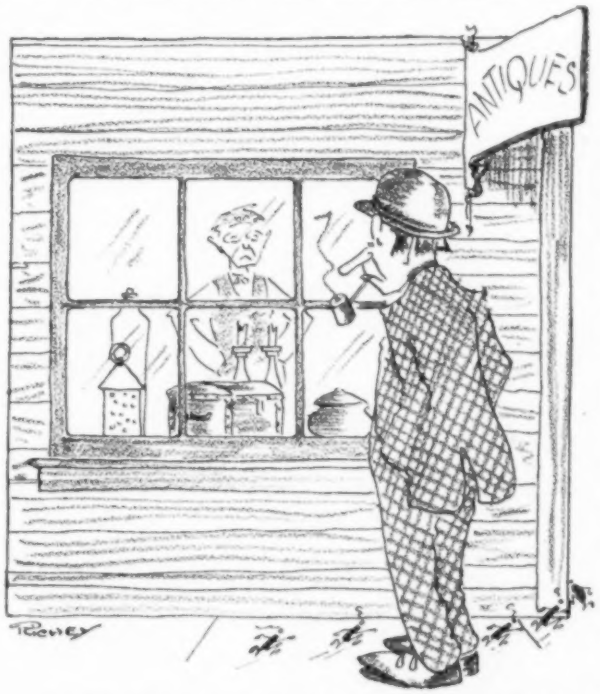
"However, the taint is there in nearly every person and as a result it is not surprising to find that certain astute gentlemen capitalize on the knowledge to their own advantage. The faking of antiques, furniture, pictures and household utensils has been developed into quite a flourishing industry despite many exposures. Have I ever told you of the antique lantern I found in Lancaster?"

"Which Lancaster?" I naturally inquired. "Pa., N. Y., O., or the town on the bank of the Lune in England? Also, where is the precious lantern? Am I to infer that you have been holding something out on me?"

"What do you mean, holding something out on you?"

"Why, you just said you found a lantern—"

"Yes," Bill replied tartly, "and Admiral Byrd found the South Pole, but that does not necessarily imply that he brought it home with him. You are almost as dumb as the lad who carried home the red lantern. When his father asked him where he got it, he said he had found it close to a big hole in the road where some careless person had lost it. So far as I know, the lantern I discovered still is reposing inside the window of a store in Lancaster. While strolling idly down the street I noticed a display of antiques and curiosities in this window and I stopped for a few minutes to examine them. This old tin lantern occupied a place near the center and bore a tag announcing to all and sundry that it might be acquired for the trifling sum of $9. Apparently it dated back to a time when candles were the only source of illumination. The light from the candle was diffused through a great number of small holes punched in



Market Quotation: Price of Scrap Is Going up

the tin. Instead of punching the holes in formal straight lines, the lantern maker had given his artistic fancy free reign and the result was a marvelous combination of scrolls and whorls.

"The general scheme of decoration was strangely reminiscent of the modern habit of decorating the pad attached to a telephone. How do you account for the habit some people have of unconsciously tracing designs with a pencil while talking over a telephone?"

"Why do some people bite their nails?" I replied, impatiently. "How do I know? Anyway, who cares? Why do some people hop from one subject to another? For the love of Peter—and if necessary, Paul—stick to one thing. What about this lantern you found and yet did not find. Is the story finished?" "Finished?" Bill echoed in surprise. "Finished? My dear lad, that is only the beginning, the background, you might say, to prepare your mind for the climax. The whole art of story telling is based on this principle. Prepare a suitable background and casually introduce an item that will stick in the listener's or reader's mind. The subsequent development of the story may lead far afield, but gradually and almost imperceptibly, the various paths will converge toward a common center and that center will be the apparently trival item introduced casually at the beginning." "I don't know about the central item," I said, "but certainly if the ability—or the crime—to wander far afield is one of the qualifications of story telling, you are wasting your time in the foundry."

"The night is young. What's your hurry? To hear you talk one would imagine that every one of your minutes was a blob of yellow gold waiting to be coined. As a plain matter of fact you know that if you were not listening to me, you would have your nose stuck in a silly book following the mythical adventures of a lot of mythical people.

"Here I am giving you a chapter from real life, something that may save you real money in the event that you ever become inoculated with the virus of antique collecting. Instead of hanging breathlessly on every word, begging for further details, you callously intimate that you are not interested. In your sublime ignorance you suggest that I cut it short! Rank ingratitude I calls it!"

Deep and impressive silence on the part of the party of the second part.

Instead of accepting this tacit rebuke in the proper spirit, Bill apparently construed my silence as an invitation to continue. Some people are like that. Absolutely no hope!

"I had a little business to attend to," he said, "at the extreme south end of the town and since the day was fine and I had plenty of time I decided to give the old dogs a workout instead of riding in a street car or of chartering a taxi. My time is not as valuable as that of some people I could mention. Also I derive a considerable amount of pleasure from rambling through the streets of a strange town."

"You are some rambler," I admitted. "I can see the end of the story right now. You kept on rambling until you were lost far beyond the outskirts of the city. Darkness had fallen and a cold drizzling rain had chilled you to the bone—all the bones from the one on top of your neck to the little crooked collection in your old yellow hoofs. Far from home and mother you practically had abandoned all hope of rescue when all of a sudden you saw a dim light bobbing in the darkness.

Wonder Where He Hid the St. Bernard Dog?

"Answering your feeble shout the light came nearer and nearer. You were saved!

"The light came from the old tin lantern in the hands of the proprietor of the curiosity shop. He had seen you gawking through his window in the afternoon and with unerring instinct had sized you up as a poor unfortunate who would bear watching.

" 'You mark my words, Maria,' he had said to his wife, 'there is a bird who does not know whether he is coming or going. Before night he'll be lost like one of these here now babes in the wood, with robin red breasts hopping all over him and covering him with wet and smelly dead leaves. I kinda reckon, Maria, its my christian dooty to take this here $9 lantern, foller him up and kinda keen an eye on him.' "

"A fat lot you know about these lads who run curiosity shops," Bill said. "In their eyes all mankind is divided into two classes: The live ones who buy their stuff and the dead ones who are not interested in their wares. In this respect they do not differ materially from you or me or any other member of the great human family. We are all interested in the greatest good to the greatest number and the greatest number still is No. 1. There is one statement that will stand the closest scrutiny.

"The only possible consideration that would have induced the keeper of Ye Olde Curiosity Shoppe to carry that precious lantern out in the wind and rain would have been a $10 bill, in hand well and truly paid, $9 for the lantern and $1 for the usual service charge.

"However, in this instance, as usual, it is you and not the lantern that is all wet. Any old time I become lost I shall send you a postal card granting you permission to place me in a curiosity shop. You're a fine lad to talk about getting lost. I suppose you have forgotten that night we were leaving Detroit and you thought the boat was going in the wrong direction. How about the Third Avenue subway in New York? Do you remember that night in Boston when you started for Cambridge and came to the surface somewhere out in South Boston? Why right here in Cleveland—" "All right," I hastily interrupted. "All right. I'll take your word that you were not lost. Carry on, dear lad. What happened to you?" "I kinda figured that would hold you," Bill remarked kindly. "Just cock up your little furry ears and follow me closely. The walk down was so pleasant, I decided to return to the starting point in the same manner, but for variety I chose a parallel street. Whereas the buildings on the first street principally were devoted to mercantile purpose, I found the second street was lined on both sides by residences. Therefore when I noticed one that had been converted into a modest tin smith shop, I stopped for a moment to gaze in the window.

"From the sign on the window I gathered that the proprietor was prepared to handle all kinds of guttering, spouting and sewering and that repairs would enlist his most earnest attention. In support of this claim he displayed several examples of his handicraft.

"I was not particularly interested in the cunning arrangement of pipes in various sizes and shapes, but my curiosity was aroused when I spied two tin lanterns identical in every particular with the lantern I had seen in the curiosity shop.

"Stepping inside I found the prop. and his helper engaged in fashioning an intricate piece of pipe. To my modest inquiry he replied courteous-

ly that he knocked out them there lanterns occasionally in his spare time from old scraps of tin plate. The retail price was $2 per, but if I wanted a number why, he'd be glad to make the price right."

"Ah! yes," I said. "The point of the story as I see it, is that you saved $7 on the deal."

"Theoretically, yes," Bill replied, "but as a plain matter of fact I saved $9. I did not buy a lantern in either place. Unfortunately the money I saved was the same kind of money the average man makes in the stock market, purely imaginary."

"It is not all imaginary," I objected. "Also you must admit that it comes easier than the money you make in the foundry." "Well," Bill admitted, "the foundry is not a bed of roses, but it is not such a bad old business, if conducted properly. That reminds me of an inquiry I had recently from a man who was going into the foundry business. He said that he was building a cupola to line up to 28 inches for melting iron for light work, stove plate, plow points, etc. I imagine he is located in a small town and intends to cater to an agricultural district. He had a fan with a rated capacity of 2000 cubic feet of air per minute against a pressure of 9 ounces. He wanted to know if four 4 x 6-inch tuyeres, each with a dividing rib ⅜-inch thick in the center would render satisfactory service. I told him that he could melt iron with the equipment and under the conditions outlined, but it will cost more and his heats will cause more trouble than that involved in fitting his cupola up properly in the first place. The fan is too large, the blast pressure is too high and the proposed tuyeres are too small both in sizes and number.

"A 28-inch cupola when operated properly has a melting capacity of approximately 3 tons per hour. This will require the admission of 90,000 cubic feet of air in the same period. The present fan running under the conditions indicated in the inquiry will deliver 120,000 cubic feet of air per hour, or about 50 per cent more than necessary, after allowing for leaks, friction, slippage of belts and other contingencies.

"Where a high bed is carried, a pressure of 9 ounces is not excessive for a small cupola, but in this particular case I assumed that the heats will be comparatively small. The bed will be low and therefore a pressure of 6 ounces will be sufficient and more suitable. A high blast pressure, particularly in a small cupola, is a prolific cause of hard iron and of blow holes in the castings. The iron is oxidized and an excessive amount of silicon is burned out.

"Assuming that the cupola is lined from the bottom to the charging door in the usual manner, that is with two courses of brick, one laid flat against the shell and the other laid on edge, the shell will measure 42 inches in diameter, or 132 inches in circumference. I suggested that he cut twelve 4 x 6-inch openings in the shell. Then by casting 12 plain, rectangular tuyeres 4 x 6 inches and building them into the brickwork, he will have a practically continuous tuyere on the 28-inch diameter circle.

"The tuyeres should be made about 1 inch less than the thickness of the brick lining to prevent molten metal and slag from adhering to the ends. For example, on a 7-inch lining, the tuyeres will be 6 inches in length. On a 9-inch lining they will be 8 inches long, and in the event that a single 4-inch lining is employed, they will be only 3 inches in length.

$2 a Pound Is High for Light Work

"Economy suggests the installation of a smaller fan with a motor in keeping. However, a possibility exists that the fan is to be driven by a belt and in that case the driver and driven pulley may be adjusted to a speed that will deliver the proper amount of air to the cupola, in this instance 1500 cubic feet per minute.

"In the event that the large fan is direct motor driven, a blast gate may be inserted in the main blast pipe and the volume of air throttled down in this manner. However, this will mean a waste of power in the use of a motor larger than is necessary. In fact the only advantage of this arrangement is the equipment will be available, in the event that for any reason, the diameter of the cupola is increased by the removal of a thickness of brick from the lining. Manifestly this only is possible where a double thickness has been in existence originally.

Personnel of Advisory Committees Selected

American Foundrymen's association is forming an advisory committee for each of the four divisions of its activities. The groups will act in a general advisory capacity for their respective divisions and will function under the committee on correlation of divisional activities of which Vice President E. H. Ballard, General Electric Co., West Lynn, Mass., is ex-officio chairman. The personnel of the gray iron and malleable divisions are as follows:

GRAY IRON: H. Bornstein, Deere & Co., Moline, Ill., chairman; R. S. MacPherran, Allis-Chalmers Mfg. Co., Milwaukee; Arnold Lenz, Chevrolet Motor Co., Saginaw, Mich.; John H. Ploehn, French & Hecht Inc., Davenport, Iowa; Thomas Stewart, J. I. Case Co., Racine, Wis.; J. A. Capp, General Electric Co., Schenectady, N. Y.; B. H. Johnson, R. D. Wood & Co., Philadelphia; Dr. F. C. Langenberg, United States Pipe & Foundry Co., Burlington, N. J.; Max Kuniansky, Lynchburg Foundry Co., Radford, Va.; and J. T. MacKenzie, American Cast Iron Pipe Co., Birmingham, Ala. MALLEABLE: Frank M. Robbins, Ross-Meehan Foundries, Chattanooga, Tenn., chairman: C. S. Anderson, Belle City Malleable Iron Co., Racine, Wis.; R. E. Bryant, Jefferson Union Co., Lockport, N. Y.; P. C. DeBruyne, Moline Malleable Iron Co., St. Charles, Ill.; E. E. Griest, Chicago Railway Equipment Co., Chicago; E. A. Gullberg, Union Malleable Iron Co., East Moline, Ill.; John C. Haswell, Dayton Malleable Iron Co., Dayton, O.; S. Mackay, associate professor, University of Wisconsin, Madison, Wis .; F. C. Rutz, Rockford-Northwestern Malleable Iron Co., Rockford, Ill.; H. A. Schwartz, National Malleable & Steel Casting Co., Cleveland; E. Touceda, consulting enginneer, Malleable Iron Research institute, Albany, N. Y.; L. C. Wilson, American Chain Co., York, Pa.; and F. L. Wolf, Ohio Brass Co., Mansfield, O.

Make Process Pictures

Harbison-Walker Refractories Co., Pittsburgh, recently has completed a 5000-foot motion picture depicting the manufacture of refractories. The film shows each step in the making of refractories from the mining of raw materials to shipping the finished product. The process story is available without cost to technical societies, engineering and industrial organizations, universities, etc. Information may be obtained from the Harbison-Walker Refractories. Co.

Hardening Gray Iron

May Have Industrial Applications

By A. F. Shore

OF ALL the useful metals in the arts gray iron doubtless has been investigated least, and in consequence, there appears to be a comparative lack of available comprehensive knowledge on the subject, especially with respect to its heat treatment. However, the time has come, when this branch of metallurgy shall receive its due share of attention, both from the works engineer and the metallurgist, and there is little doubt that the results amply would justify intelligent labors expended in this direction.

Chemical Changes Occur

To the author's mind, fruitful investigations of gray iron have been retarded materially by what appear to be fallacious beliefs about what chemical changes occur during heat treatment and especially with respect to annealing. Many appear to have taken it for granted that when gray iron is subjected to annealing heat treatment, the combined carbon is reduced to temper carbon, and if the annealing operation is continued long enough malleable iron must result.

According to some experiments in attempting to obtain satisfactory hardened surfaces by heat treatment of gray iron after machining, there appears to be a series of pre-graphite stages, which may be utilizable with substantial, and if not incalculable benefit to the arts, and even in the field of modern high duty machine construction, as in connection with reciprocating motors, etc. One thing is well known and which doubtless had much to do with the discouragement of the heat treatment of gray iron and that is the growth in size by prolonged exposure to heat.

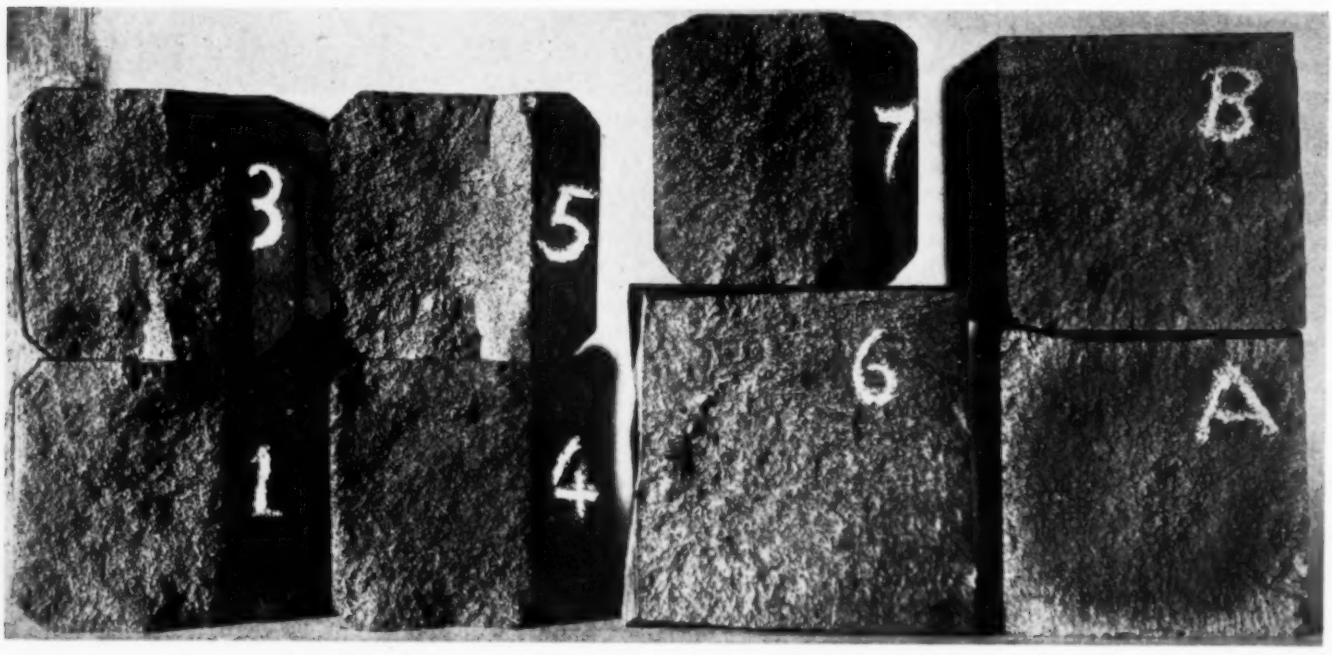
For example, gray iron can be carburized nearly as readily as mild steel. While it is true that all ferrous metals so carburized **increase** in size due to the absorption of carbon, gray iron grows in size independent of this, so that it is almost out of the question to carburize gray iron after machining without elaborate grinding in the process of **fitting** unless an extremely thin case is acceptable, such as for example, a half hour of exposure.

Ordinary gray iron when sand molded under standard foundry practice has little or no hardening properties when reheated and quenched after the manner of tool steel. In fact, even in sections as small as $\frac{3}{8}$-inch in thickness, or less, in which the hardness runs up as high as 40 scleroscope (225 brinell) which would appear to indicate a certain amount of combined carbon that should be available for hardening purposes upon quenching, it may not respond to an increase of more than 10 per cent in hardness.

Theory Is Tested

To test out the outright hardening in gray iron due to presence of combined carbon, some bars $1\frac{1}{8}$-inch square, which were cast in an iron chill mold were used. The bars attained a hardness on the surface of 78 scleroscope (520 brinell) to a depth of $\frac{1}{16}$-inch, with a hardness of 50 in the core, as indicated in the fractured surface at *A* in accompanying illustration. It was found that by subjecting the sample to a temperature of 1750 degrees Fahr. for 2 or 3 hours, that the hardness at the surface due to the chill was brought down to 35 scleroscope and in condition for machining with the greatest ease.

The sides of the sample then were planed parallel and the sample re-



Appearance of the Fractured Surfaces of the Various Specimens Used

heated to 1450 degrees Fahr. and quenched in water. Substantially all the hardness imparted to the original surface in the chill mold was recovered, namely 78 scleroscope. Not only this, but the hardness extended clear to the center of the bar where it was even a little higher than on the outside.

The same annealing treatment was then applied to an alloy casting containing 4.50 per cent nickel and 1.50 per cent chromium, which had also been cast in a chill mold, the original fracture of which is shown at 6 in the illustration. The alloy sample failed to respond to the annealing treatment for the purpose of machining. It can be seen that, with chemical composition favoring, even gray iron can be chill cast for the purpose of combining a certain amount of its carbon for the first operation, then annealed for the second operation and finally rehardened after the manner of tool steel as the third operation.

Fails to Harden

Another sample of deep chilled gray iron of unknown composition such as is used for chilled rolls, which originally had a hardness of 72 to 75 could be annealed down to 50 scleroscope, which was most too hard for machining. The sample was 1¾-inch square and fluid chill hardened all through. This sample after three hours of exposure to 1750 degrees Fahr., cracked severely especially at the surface, doubtless due to the effect of growth of the iron upon an unfavorable chemical or crystalline structure. The sample was not hardened because of its apparent unsuitability for the purpose in view, namely to harden outright after machining.

Encouraged by the results obtained in utilizing the combined carbon of chilled gray iron, after annealing for hardening purposes, on the one hand, and as a result of discouragement due to the tendency to internal strains or cracking in the annealing treatment of ordinary gray iron, some samples of black heart malleable iron, having a thickness of ¼-inch and a width of 2 inches were tried. These were found to have a hardness of 25 as received.

After barely removing the rough scale, one of the samples was heated to 1450 degrees Fahr. and quenched in water. The hardness increased from 25 in the annealed state to 85 scleroscope and extended clear through. In this condition it was weak and brittle, showing a grain like severely over-heated eutectoid quenched carbon steel. Upon reheating to 800 degrees Fahr. the hardness dropped to 55, developing not only comparatively high strength but a marked degree of malleability.

The unit strength was not tested out in the usual way, but in clamping a corner in a bench vise, it did not break off under the blows of a hammer, but rather would batter at the corners, without fracture. Upon taking a better grip in the vise, the sample broke, not at the point of the greatest strain, but along what appeared to be a water crack in another part. How the tendency of cracking may be avoided chemically or otherwise, in the history of the specimen up to the quenching point is food for thought.

Next a series of nickel alloy gray irons which were sand cast and easily machineable were tried. These had a diameter of 1¼-inch and are known as standard arbitration test bars. Specimens 1 inch were prepared from these and were measured with a micrometer as to exact size before heating treatment. The heat treatment consisted merely of heating to 1450 degrees Fahr. and then quenching in water.

Although no claim had been made to that end of which the author is aware, it was found that responsive to this treatment, the nickel alloy gray irons easily hardened from 70 to 80 scleroscope. The hardening was not only at the surface, but substantially all through the bar, and with a distribution of marked uniformity. No checking or cracking of any kind as in prevous instances could be detected in any of the samples. There was little or no growth noted and the specimens did not swell much more than ordinary eutectoid carbon steel subjected to similar treatment, being 0.002-inch per inch.

Temper Is Obtained

Alloy gray iron hardened in this manner may be tempered the same as carbon tool steel. It also gains in strength. One specimen having a composition of: Total carbon, 2.70 per cent; silicon 1.71 per cent, and nickel, 2.42 per cent withstood a transverse load according to standard arbitration bar ratings of 4500 pounds. The specimen upon quenching hardened up to 80 scleroscope. Upon reheating to 750 degrees Fahr. it dropped to 60. That treatment increased the strength to nearly 15,000 pounds or over 200 per cent.

The effect of nickel in gray iron, perhaps with some exceptions, is the same as in steel. In steel it has the effect of sensitizing it for the hardening transformation in quenching. In fact, it has such a radical effect upon steel that where in ordinary carbon steel a hardening depth of less than ⅛ inch may be obtained, the addition of nickel would cause the hardening to penetrate to a depth of between 1 and 2 inches as is done in the manufacture of armor plate and projectiles. In addition to this it probably has much to do with the retention of enough combined carbon in the slow chill of a sand mold to impart hardening qualities to the casting (without materially increasing resistance to machining) that could not be obtained in gray iron in the absence of it, when heated and quenched in a similar manner and as previously described.

From the foregoing it is evident that great improvements can be made especially in imparting wear resistance to machine and other surfaces of gray iron in which precision of functioning depends upon the original size or alignment. These parts woud have to be designed in a manner to avoid warping in the quenching processes, that is, the use of cross sections as uniform as possible. If this heat treatment could be adopted, it would mark a distinct advance in automobile motor efficiency. In fact, it would supply the missing link in automotive assemblies which would impart to the motor the same life as the other parts of the car.

Examines Wear Resistance

A study of the bibliographic data on the subject of wear resistance in gray iron has been so deceiving as to almost discourage the investigator. However, it is safe to assume that not all the vital factors that enter may have been duly taken into account. Some even have gone so far as to say that the increase of hardness to certain surfaces did not necessarily increase its resistance to wear. For example, it had been found that a softer member may readily cause the harder member to wear most. This probably is due to the softer member becoming a potential grit carrier or kind of lap, for the reason that its relative hardness was incorrect and perhaps too low.

H. Bornstein in *Transactions* of the American Society for Testing Materials, however, has shown that wear resistance, of which gray iron cylinder walls are a notable example, thus depends not only upon the hardness of the cylinder walls, but also the combined carbon in the walls. Therefore, it is quite logical to assume that if the hardness can be doubled, which under the heat treatment plan is not difficult even after letting down the temper under a temperature of 750 degrees Fahr. the wear resistance may also be doubled, if not trebled, providing certain contending factors are met scientifically. Observations of the author have been that if gray iron contains free silica or such gritty particles, which he believes it usually does, it becomes the controlling factor in wear resistance tests. For example, a gray iron that may be machined easily will quickly wear out a finely hardened tool steel member moving or in contact with it, because of the free grit that it contains. This would suggest, therefore, an acid treatment to dissolve the grit at the

finished wearing surface, so that only the true metals actually come in sliding contact.

Prevents Unsoundness

(*Concluded from Page* 51)

Unsoundness in bronzes and red brass may be reduced greatly and in many cases eliminated by careful attention to the following factors: Cooperate with the engineers and designers to provide logical casting design which advocates uniform sections wherever possible; see that the castings are gated properly with risers and gates arranged to feed the casting, and not vice versa; use good raw materials whose compositions are known; melt the metals quickly employing neutral furnace atmospheres; regulate the pouring temperature to the casting and maintain good ladle and pouring practice, and last but not least, pay attention to details, provide careful technical supervision and arrangement, and hold workmanship to a high standard.

Transfers Ownership

The controlling ownership of the Glancy Malleable Corp., Waukesha, Wis., has been transferred from R. A. Glancy to L. A. Williams, vice president and L. D. Harkrider, secretary and treasurer. Mr. Williams and Mr. Harkrider have been in active charge of the business since the company was formed in 1923.

The plant originally was built in 1893 and operated under the name of the Waukesha Malleable Iron Co. until 1920 when the plant was leased to the Samson Tractor division, General Motors Corp. for producing castings for its tractor plant at Janesville, Wis. When the General company discontinued the manufacture of tractors, Mr. Glancy purchased the lease. Later he and his associates, Mr. Williams and Mr. Harkrider, organized the Glancy Malleable Corp., and the plant has been operated under that name.

Mr. Glancy, who is a vice president and director, General Motors Corp., Detroit, will be chairman of the board of directors; P. J. E. Wood, president; W. H. Bennett and L. A. Williams, vice presidents; and L. D. Harkrider, secretary and treasurer. The board of directors includes Mr. Glancy, Mr. Wood, Mr. Bennett, Mr. Estberg, Mr. Williams and Mr. Harkrider. Mr. Glancy will continue as active directing head of the company.

Runners Are Staggered for Clean Castings

By Thomas Johnson

A method of gating which we have adopted with satisfactory results for securing clean castings is shown in the accompanying illustration. It may be adapted to a single casting or to several castings in one flask. Many instances arise where castings cannot be poured satisfactorily through horizontal gates at or near the joint. For example the bevel gear shown in the illustration cannot be gated in this manner. Two methods are available. It may be poured from the bottom through a horn sprue, or, it may be poured from the top through a pop gate on the hub. The horn gate represents extravagant practice on account of the amount of metal required to fill it. A single large pop gate on the hub allows dirt to flow down with the iron into the casting. The style of gate shown, requires only a minimum amount of metal and practically constitutes an insurance feature against dirty castings. The small gate pins may be rammed up with the pattern or small pop gates may be punched through the cope either before or after it is lifted. An auxiliary cope is rammed on top of the regular cope and after it has been lifted off, a channel is cut in the sand to connect the vertical runner in the auxiliary cope with the small runner or runners in the cope above the casting. Side and front views of a tank casting, indicate how the gate may be applied to castings of this type.

Purchases Interest in Erb-Joyce Foundry

Wilcox Rich Corp., Detroit, has purchased an interest in the Erb-Joyce Foundry Co. which operates plants at Vassar and Howell, Mich. Fred Erb, president of the Erb-Joyce Foundry Co. will continue as president and general manager and C. H. L. Flinterman, president and general manager, Wilcox Rich Corp., will be associated with him. The latter company manufactures valves, tappets, and piston rings for aircraft and automotive service. The firm is a member of the Eaton Axle group.

The Erb-Joyce Foundry Co. will manufacture castings for tappets and piston rings and will specialize in high specification gray iron castings. B. A. Joyce has retired from the firm and is spending the winter in Florida.

Makes Strong Castings

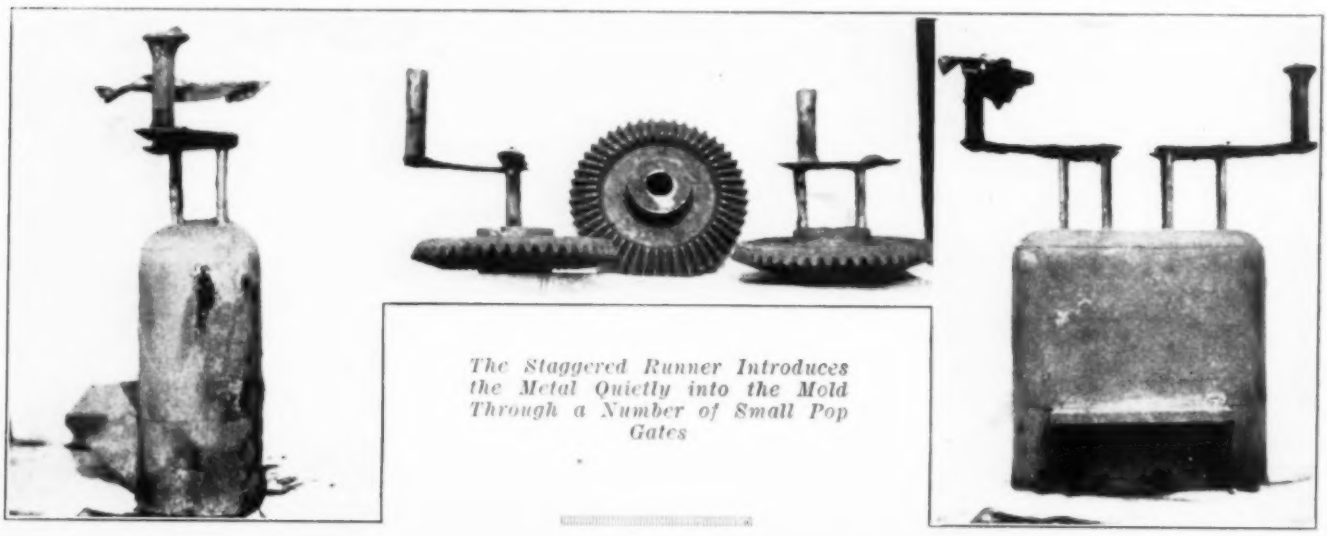
(*Concluded from Page* 55)

process when removing the castings from the mold.

At the temperatures at which many castings are removed from the sand, their strength is rather low, and rough handling may induce incipient cracks which may or may not be discovered in the most rigid inspection. Likewise, at this relatively high temperature the casting is quite ductile and can be warped out of shape easily by improper handling.

Sometimes such castings may be straightened satisfactorily when cold, but in many cases this is only possible after considerable work. It is much easier to prevent this condition by a little consideration during the shakeout than to try to remedy it when the casting is ready for shipment.

W. E. Thew Pattern & Supply Co., Greenbay, Wis., has moved from 126 to 426 South Pearl street.



The Staggered Runner Introduces the Metal Quietly into the Mold Through a Number of Small Pop Gates

R. S. MacPHERRAN

Awarded

Whiting Medal

By A. F. A.

RALPH STEWART MacPHERRAN chief chemist, Allis-Chalmers Mfg. Co., Milwaukee, one of the outstanding metallurgists in the field of gray iron, has been selected to receive the major 1931 award of the American Foundrymen's association, the J. H. Whiting gold medal. This award, which is made to Mr. MacPherran for his many valuable contributions to the foundry industry, was voted unanimously recently by the A. F. A. board of awards and since has been approved by the board of directors. The presentation will be made at the Chicago convention of the A. F. A., to be held at the Stevens hotel, May 4 to 7, 1931.

The J. H. Whiting gold medal is one of four awards made by the A. F. A. for the purpose of encouraging and stimulating meritorious achievements in the various branches of the foundry industry. Granting of the awards is vested in a permanent and self-perpetuating board of awards consisting of the seven living past presidents of the association. The J. H. Whiting medal previously was awarded to John Howe Hall at the Milwaukee convention in 1924, and to E. V. Ronceray of France at the Detroit convention in 1926.

Mr. MacPherran, for many years a prominent and active contributor to the committee work of the American Foundrymen's association and the American Society for Testing Materials, has been identified with the work of the iron and steel industry for nearly 40 years. He was born at Sterling, Ill., Feb. 1, 1871, and received his technical education at the University of Wisconsin, Madison, Wis., and the University of Michigan, Ann Arbor, Mich. He was graduated from the latter institution in 1892 with a B. S. degree in chemistry.

After leaving college, Mr. MacPherran was associated for three years with the Illinois Steel Co. at the Joliet and the South Chicago, Ill., works. In 1895 he became connected with the former E. P. Allis Co., Milwaukee. He left that firm in 1907 to spend one year with the J. I. Case Threshing Machine Co., Racine, Wis., and then returned to the newly formed Allis-Chalmers Mfg. Co., Milwaukee. Mr. MacPherran has been associated with that organization ever since in charge of its chemical and physical laboratories.

Mr. MacPherran is especially noted for his co-operation in the committee activities of several technical organizations and for the assistance he has given many young metallurgists in the field of gray iron. He was a member of the group of American foundrymen that visited Europe in 1929 to attend the International Foundrymen's congress. During the tour he was a close observer of foundry practice, particularly in connection with the production of special irons. He is a member of the American Foundrymen's association, the American Society for Testing Materials, the International Society for Testing Materials, the American Chemical society and the American Society for Steel Treating.

As a result of his continuous and valuable investigations of gray iron, Mr. MacPherran has contributed numerous papers on metallurgy of both gray iron and steel before meetings of various technical associations, as well as to THE FOUNDRY and other members of the technical press.

To List Inventions

Chamber of commerce, Cleveland, through its industrial development department, has established a service whereby inventors may submit descriptions of their devices. These will be listed in a letter sent to more than 2000 manufacturers. The man with an idea also is encouraged although it is suggested that he protect himself if he has not applied for patents. Those interested should send their communications to the industrial development department, chamber of commerce, 1704 Terminal Tower building, Cleveland.

Deoxidize Steel

Research paper No. 199 recently published by the bureau of standards gives the results of preliminary studies on deoxidation and mold conditions on the tensile strength of carbon steel castings. The work was carried out by the late J. V. McRae and R. L. Dowdell. The preliminary survey indicated that if the carbon content is between 0.10 and 0.17 per cent; manganese, between 0.60 and 0.70 per cent, and silicon, between 0.30 and 0.40 per cent, the addition of about 1 pound of aluminum per ton of steel to the ladle shortly before pouring will not lower the ductility below the usual limitation. A higher normalizing temperature of 2000 degrees Fahr. instead of 1650 degrees appeared beneficial. A rather high pouring temperature also appears desirable. If aluminum is added during tapping, the castings may be somewhat porous. Porosity often can be overcome by controlling moisture and permeability of the molds. If the carbon content is about 0.20 per cent, it will be easier to meet the ductility specifications under the latter conditions as less deoxidizing agent has to be used. The price of the bulletin is 5 cents. It may be obtained by addressing the superintendent of documents, government printing office, Washington.

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The Shakeout

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¶ More Light on Gates

THE foundry industry is surrounded by variables, each having a direct bearing on the success of manufacturing operations. Many of these variables contribute to imperfection in castings, and more than one quarter of all casting defects are caused by improper gating. The problem of selecting the correct method is encountered in every foundry—every day.

Starting with the Jan. 1 issue, THE FOUNDRY will present the most complete and valuable collection of information on gates, runners and risers ever published. These articles, written by Pat Dwyer, molder, foreman, superintendent and for the past 12 years, engineering editor of THE FOUNDRY, are thoroughly practical.

THE series covers the five main divisions of the industry, gray iron, steel, malleable iron, aluminum and brass. Information will be presented on theories for calculating gate areas, advantages of different speeds of pouring, stacking molds, causes of defects, shrinkage, warping, skim or strainer gates, risers, and many other features.

THE FOUNDRY recommends this series to all engaged in the foundry industry. The articles will be valuable to all molders, foremen, superintendents, technical men, designers, patternmakers and managers. Watch for the first installment of this valuable series in the Jan. 1 issue of THE FOUNDRY.

¶ Abusing the Iron Horse

SINCE common decency decreed the abolition of railway passes to politicians, given in the old days to everyone from congressmen to cross roads coroners, the railroads have been fair game for pee-wee minded legislators. True, public affection was alienated by the old-time type of railway magnate who passed out rebates with one hand and waggled the fingers of the other, slightly below the level of the eyes and aimed in the general direction of that composite human, the general public.

THE FOUNDRY is not a political organ and beyond deprecating the general idea of political tampering with economic questions, is discreetly silent. It recognizes the importance of railroads to the foundry industry, both through the consumption of large tonnages of cast products and through furnishing transportation for foundry materials and products. On this basis, and this basis alone, THE FOUNDRY believes the railroads are entitled to better consideration. Although public interest in transportation has turned from the railroad to the automobile, the airplane and spasmodically the waterways, the greatest bulk of both freight and passenger traffic is handled by railway lines. Motor bus and trucking companies under present system of operation enjoy practically a subsidy from the public, to operate over public roads and streets. Now come further proposals for inland waterway construction.

WHETHER these waterway movements are set forward under guise of reducing freight rates for certain regions and certain classifications of commodities, or whether the hue and cry is based upon relieving unemployment, the railroads will bear the brunt. The result can mean only increased rates for railroads, decreased income, hampered operation and disintegration. Ghosts of steamboatin' and canal barge days should give warning of the waterway transportation fallacy.

¶ Many Toys Are Cast

A TRIP through the toy department of any merchandising establishment, from the 5-and-10 to the largest department store, will reveal the remarkable development that has taken place during the past year in the manufacture of cast toys. Santa's pack will be heavy this year, because it will be filled with sturdy cast toys to gladden the hearts of Young America.

VARIETY has been the keynote in the development of cast metal toys. Practically every manufactured article, common to the boy and girl of today, has been reproduced in minature, with the greatest attention given to minute details. For example, in copying one type of automobile, which is equipped with wire wheels, the manufacturer of the cast toy has succeeded in designing a casting which ably represents the wire wheel. Everything in the line of motor vehicles, construction equipment, household furnishings, trains, animals, soldiers, Indians, etc., may be obtained in cast metal, all finished in the brightest of colors to attract and hold the attention. Gray iron, nonferrous and die casting shops all have contributed to the progress in the manufacture of cast toys. Foundries now occupy an important place in the toy industry of the world.

Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

ERNEST LANCASHIRE, formerly connected with the American Steel Foundries, Chicago, at the Granite City, Ill., and the Alliance, O., plants, has resigned to become associated with the West Michigan Steel Foundry Co., Muskegon, Mich., as metallurgist. Mr. Lancashire received his metallurgical training at Sheffield university, Sheffield, England. Later he served as assistant in the Brown-Firth Research laboratories, Sheffield, and as shift chemist for the Newcastle Alloy Co., Newcastle-on-Tyne, England, manufacturers of both basic and acid electric steel. Mr. Lancashire came to the United States in August, 1923, and entered the employ of the American Steel Foundries as metallurgist and research chemist, Granite City plant. Later he resigned to become metallurgist, Standard Brake Shoe & Foundry Co., Pine Bluff, Ark. He served with that company for 2 years when he became instructor in heat treatment of metals and microscopic analysis of iron and steel, University of Illinois, Urbana, Ill. He resigned that position in 1929 to return to the American Steel Foundries, Granite City, Ill. He was transferred to the Alliance plant of the company in Feb., 1930 and assigned to the wheel department.

William T. Adams, president, Berks Foundry & Mfg. Co., Hamburg, Pa., recently was the guest of honor at a dinner celebrating the fifteenth anniversary of the company and also his birthday.

C. C. Handley, Chain Belt Co., Milwaukee, will address the Dec. 15 meeting of the Quad-City Foundrymen's association which will be held at the Fort Armstrong hotel, Rock Island, Ill. Mr. Handley will speak on "Malleable Practice."

Harry B. Parker, vice president, Albion Malleable Iron Co., Albion, Mich., was a member of the committee which represented the state of the twenty-sixth national congress on rivers and harbors recently held in Washington.

Thomas Bradshaw, president, Massey-Harris Co. Ltd., Toronto, Can., has resigned to devote his time to the North American Assurance Co., of which he is president. T. A. Russell, vice president of the Massey-Harris company has been appointed acting president.

Martin Brockmann, for the past 16 years in charge of the foundry division, Cincinnati Milling Machine Co., Cincinnati, has resigned his position to become superintendent, John B. Morris Foundry Co., Cincinnati. When Mr. Brockmann tendered his resignation, his associates presented him with an engraved, gold watch.

J. E. Hart, formerly general superintendent, Walworth Co., Boston, has been appointed works manager. Mr. Hart became connected with the Kewanee, Ill. plant of the company which at that time was known as the Western Tube Co., as clerk in the pipe finishing department. Three years later the Western company purchased the well point business of the Scott Well Point Co., Chicago. Mr. Hart was placed in charge of the well point work and in 1907 his supervision was extended to include the nipple and radiator departments. The Western company was acquired by the Walworth Co. in 1917 and Mr. Hart became a part of the latter organization. He was given charge of the rating department of the Kewanee works in 1920, later was appointed assistant supervisor of planning work. He went to Boston in 1923 and shortly after was appointed general superintendent. He held that position until his recent advancement.

Ernest Lancashire

Chester L. Erickson, formerly assistant to the general superintendent, has been appointed superintendent of production, Walworth Co., Boston. Mr. Erickson began his career as a machine shop apprentice. Later he was connected with Gray & Davis, Williams Tool Co. and then was in charge of Driggs Ordnance & Mfg. Co., New Haven, Conn. He was appointed time study and methods engineer of the Boston works, Walworth Co., in 1924 and later became assistant to the general superintendent, a position which he held until his recent promotion.

J. Frank Dorney, formerly supervisor, rating and methods division, Walworth Co., Boston, has been appointed assistant to the works manager. Mr. Dorney was born in Newtonville, Mass., where he received his early education. He was graduated from Dartmouth college in 1921. Following graduation, he became connected with New England Telephone Co., Boston. He became associated with the Walworth Co. in 1923 in the finishing department of the stillson wrench and tool division. Later he was assigned to time study work and in 1923 was appointed supervisor of the rating and methods department.

Lorenz Iversen, vice president, Mesta Machine Co., Pittsburgh and West Homestead, Pa., has been elected president to succeed the late Harry F. Wahr. Mr. Iversen has been associated with the company for many years. Prior to his election as vice president in 1925 he was chief engineer. L. W. Mesta has been elected vice president. He formerly was assistant general superintendent and has been with the company since his graduation in mechanical engineering in 1911 from the University of Pittsburgh. F. A. Mesta has been elected director to fill the vacancy on the board caused by the death of Mr. Wahr.

Presly N. Guthrie Jr., vice president in charge of sales, Reading Iron Co., Reading, Pa., a subsidiary of the Philadelphia & Reading Coal & Iron Co., Philadelphia, has been elected president of the former company. He succeeds Leon E. Thomas, who resigned July 31. Mr. Guthrie was born in Pittsburgh, April 26, 1876, and received his initial business training with Park Bros. & Co., owners and operators of Black Diamond Steel Works, the nucleus of the present Crucible Steel Co. of America. His next connection was with the natural gas division, Philadelphia Co., Pittsburgh. He later returned to the iron and steel business as sales agent and general manager of sales, Longmead Iron Co., Conshohocken, Pa. In 1909 he had charge of sales, South Chester Tube Co., Chester, Pa. While on a leave of absence from July, 1917, until the end of the World war, he served the government as assistant director, bureau of oil well supplies, oil divi-

sion, United States fuel administration. He returned to South Chester Tube Co. and in February, 1919, was made manager of sales, in which capacity he served until his resignation in December, 1929, to become vice president in charge of sales for Reading Iron Co.

Rounds Out 50 Years with One Company

On Nov. 28, Job Goostray celebrated his eightieth birthday anniversary and a few months better than his fiftieth year of service with the Hunt-Spiller Mfg. Corp., Boston. He entered upon his fifty-first year of continued service with the company in August. The occasion was marked in the company dining room by the presentation to Mr. Goostray of a basket containing 50 roses, accompanied by a letter from J. G. Platt, president of the Hunt-Spiller Mfg., Corp., complimenting the recipient on his long and faithful service. Not the least interesting feature of the occasion was a birthday cake with 80 candles.

Job Goostray was born in Manchester, England, Nov. 28, 1850 and at the age of 12 was apprenticed to the trade of molding. As a young man of 20 he came to the United States and for 10 years worked in various shops in New England. He secured employment in 1880 with the South Boston company that later became the present Hunt-Spiller Mfg. Corp.

Later he was appointed foundry superintendent, a position he held until a few years ago when he was relieved of active duty and retained in an advisory capacity. He still is hale and hearty and was one of the group of American foundrymen who attended the International Foundry Congress in London in 1929.

Milwaukee Will Hold Apprentice Contests

Contest for more than 100 metal trades apprentices will be conducted during the winter by the Milwaukee branch of the National Metal Trades association, W. J. Gibson, apprentice supervisor. Harnischfeger Corp., Milwaukee, is chairman of the committee in charge of arrangements for the contests.

Apprentices will be divided into 4 groups, machinists, draftsmen, patternmakers and molders. Specific problems will be given in each craft and prizes will be awarded. Patternmaker and molder apprentices will be given problems prepared by the American Foundrymen's association. The three best in each group will be entered in a national competition. Tests in molding and patternmaking will be held shortly after the beginning of the new year.

Pioneer Foundryman Dies at Pittsburgh

Isaac W. Frank, one of the leading foundrymen of the Pittsburgh district and former president of the United Engineering & Foundry Co., Pittsburgh, died in that city Dec. 1. Mr. Frank was well known throughout the foundry industry for his pioneer work in the organization of the American Foundrymen's association and the National Founders association. He was born Dec. 2, 1855 and obtained his early education in the Pittsburgh public schools, Newell institute, and Western University of Pennsylvania, now the University of Pittsburgh. Mr. Frank was graduated from Rensselaer Polytechnic institute, Troy, N. Y., in 1876 with a degree in civil engineering. His initial employment was as draftsman with the Keystone Bridge Co., Pittsburgh. He remained with that company about a year, working on plans for the New York Elevated railway. Later he served as inspector of materials for that company. In 1879 and 1880 he was engaged in mining work in Leadville, Colo., and then returned to Pittsburgh to build a new foundry for the Lewis Foundry & Machine Co. He remained with that company until 1892 during which time he was secretary and engineer.

Isaac W. Frank

In 1892 he organized the Frank-Kneeland Machine Co. The success of the company led to the formation of the United Engineering & Foundry Co., in 1901. That company was organized by the consolidation of 7 manufacturers of rolls, rolling mill and steel mill equipment in the Pittsburgh district, and Mr. Frank was chosen as the first president. He retired in 1919 but held an interest in the company through his position as chairman of the executive committee.

Mr. Frank was one of the organizers of the Pittsburgh Foundrymen's association and served as its first president. He also was interested in the formation of the American Foundrymen's association. He attended the first meeting of that association and at Detroit the following year was one of the members who engaged in the preliminary work leading up to the formation of the National Founders' association. He was active in its councils for many years as chairman of the third district, vice president and president. Mr. Frank recently celebrated his fifty-fourth year in industry and would have celebrated his seventy-fifth birthday the day following his death. He was an officer and director of many companies and was interested in educational and philanthropic matters. He was a trustee of the University of Pittsburgh and a former president of the Pittsburgh Employers' association.

OBITUARY

George W. Kelly, 65, one of the well known foundrymen of the South, died Nov. 22 at the home of his daughter Mrs. F. W. Cunningham, Macon, Ga. Mr. Kelly had retired about 2 years ago after having been superintendent, Golden's Foundry & Machine Co., Columbus, Ga., for nearly 30 years. He also had been associated with Schofield's Sons Co., Macon, Ga. He was co-inventor with Mr. Blaw, foreman, pattern department, Golden's Foundry & Machine Co., of a core machine.

David E. Miles, 61 years old, general manager of the No. 3 plant, Moline Iron Works, Moline, Ill., died recently. Mr. Miles had been foundry foreman of the Union Malleable Iron Co., East Moline, Ill., for about 31 years, and for the past 10 years had been connected with the Moline Iron Works.

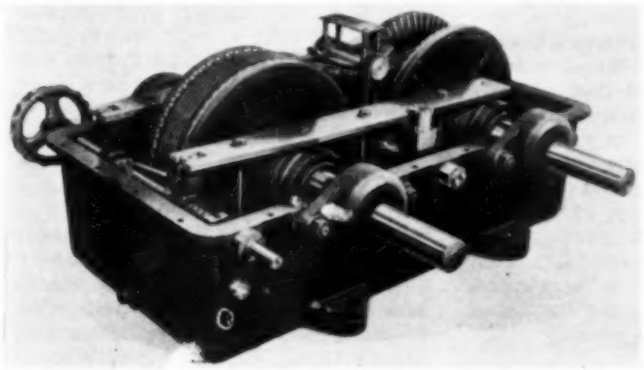
W. M. Graddy, general foundry foreman, Golden's Foundry & Machine Co., Columbus, Ga., died recently at his home in that city. He had been associated with the company for more than 15 years. Mr. Graddy spent about 25 years in the foundry industry in various capacities.

Michael J. White, treasurer, United States Hoffman Machinery Corp., Manhattan, N. Y., died at his home in Brooklyn, N. Y., Nov. 25. He had been with the company for 15 years.

According to the bureau of mines general report on copper in 1928, an increase was noted in exported brass and bronze pipe fittings and valves, hardware and plumber's brass goods. In 1927 the value of the exported material was $2,964,597 while in 1928 the value was $3,287,926 or an increase of 10.9 per cent.

Designs New Variable Speed Transmission

Link-Belt Co., 910 South Michigan avenue, Chicago, recently introduced an all-metal, variable-speed transmission driven by a side-tooth chain. The new unit consists of two pairs of wheels of the opposed conical disk type, between which a side-tooth chain transmits the power. The effective diameters of each pair of wheels can be altered under load to change the speed ratio. That is accomplished without steps and without dependence upon friction. When the speed is changed, the self-pitching chain rises in one set of wheels and descends in the other so that while the input shaft connected to a motor or other source of power turns at constant speed, the output shaft is changed to the desired number of revolutions per minute.



A Positive Chain Drive Is Used To Transmit the Power

The feature of the unit shown in the accompanying illustration is the use of a positive chain drive to transmit the power. Radial teeth are cut in the conical faces of the driving disks and the self-adjustable teeth projecting beyond the sides of the chain are arranged to engage the teeth of the disks positively. The chain used in the unit is made of a series of steel leaves or links with joints consisting of hardened steel pins turning in segmental bushings. There are no teeth on the inner surface of the chain. Side-teeth are composed of packs of hardened steel laminations which extend through slots in the links at right angles to them. Those laminations project about ⅛-inch at each side of the chain. Individual containers which hold the packs are secured in the openings of the links but the laminations in each container are free to slide from side to side individually and to adjust themselves to engage the radial teeth of the disks over the full range of diameters. The lamination ends are cut to a 30 degree angle which is approximately the same as that of the conical faces of the wheels.

Disk teeth widen from the center outward toward the circumference but are of uniform depth. They are staggered on each pair of wheels so that the laminations move back and forth into the teeth to mesh correctly as the chain comes into contact with the wheels. At each engagement of the chain and wheels, the laminations are regrouped within their separate compartments but do not slide or move under working pull. Their movement in engaging with the wheels is completed before the load is applied.

All elements of the transmission are enclosed in and protected by an oil-tight housing. The unit is splash lubricated automatically. Hardened steel wheel faces are mounted on cast iron hubs backed by ball type thrust bearings. The wheels move axially on the shafts which are mounted on radial ball bearings. The movement of the pairs of wheels to increase or decrease the effective pitch diameters, is controlled by a pair of pivoted levers operated through a hand controlled shaft with right and left hand screw motion. Initial chain tension is provided by an external adjustment screw. Correct operating tension is maintained at ratio settings by two hardened shoes which ride lightly on the upper and lower strands of the chain. The shoes are under constant spring pressure. A speed indicator permits operating speed settings to be checked easily.

The new transmission is manufactured in five sizes from 1 to 10 horsepower providing speed change ratios up to a maximum of 6 to 1.

Frequent Reversal Is Feature of Motor

General Electric Co., Schenectady, N. Y., recently introduced a new line of single-phase, repulsion induction motors capable of frequent reversal. The new motors have the same appearance as the general-purpose, single-phase motors made by the company and are interchangeable mechanically in all respects with that type with corresponding horsepower and speed ratings.

Available ratings range from ¾ to 5 horsepower at 1800 revolutions per minute and from ½ to 2 horsepower at 1200 revolutions per minute. Mechanical modifications applicable to the general purpose motors may be used with the new type. Starting torque is high and ranges from 225 to 275 per cent of normal full load running torque depending on the rating. The motor is controlled by a full-voltage, 3-pole, reversing switch which may be either manually or magnetically operated.

Grinder Operates at a Constant Speed

Hammond Machinery Builders Inc., Kalamazoo, Mich., recently placed a new, constant peripheral speed grinder on the market. The machine operates at 9000 surface feet per minute for bakelite and rubber bonded wheels and may be adjusted for use with vitrified wheels. It uses 16, 18, 20 and 24-inch wheels and may be obtained with 7½, 10 or 15 horsepower motors.

Power is transmitted from an accessible but fully protected motor mounted at the rear of the machine to an intermediate drive shaft by a multi-V belt. The belt may be replaced by removing the belt guard. Speeds are varied by quick change pulleys on the motor. The pulleys are accessible easily and carry protective

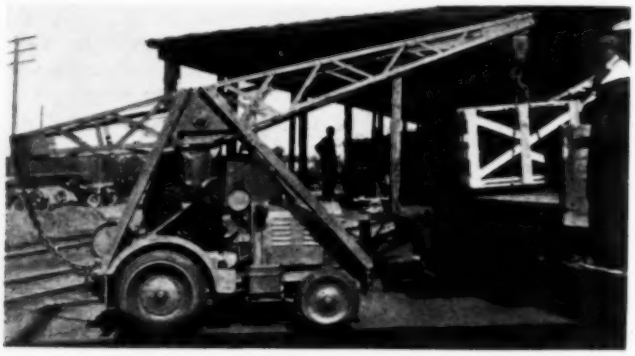
Speeds are Varied by Quick Change Pulleys on the Motor

features so that large wheels cannot operate on the faster speeds. Power is transmitted from the intermediate spindle to the main spindle by herringbone gears operating in an oil bath. The spindle is equipped with six, oversize ball bearings.

Wheel guards are adjustable to compensate for wheel wear and are fitted with shatterless glass eye shields. Spindles are made of chrome-nickel steel and are balanced accurately. The motor is protected from overload, low voltage and phase failure. Convenient oilers with oil-level gages and flushing plugs are supplied.

Variable Height Crane Has Ton Capacity

Clark Tructractor Co., Battle Creek, Mich., recently has introduced a variable height crane which has a capacity of 2000 pounds and a 13-foot lift. When the boom is horizontal, the machine has an overall height of 7 feet 10 inches. The equipment may be used for handling castings for machining and shipment, crates, bundles, boxes and other loads requiring chains or hooks. The chassis is made by the company and has a 108-inch turning radius. Equipment includes self-starter, generator, battery, head and tail lights. The engine is of the gasoline tractor type.



The Crane Has a 13-Foot Lift and a Capacity of 2000 Pounds

Study Use of Scrap in Steel Foundries

Steel castings companies in the United States consumed approximately 1,783,900 gross tons of iron and steel scrap during 1929, to produce 1,583,040 tons of castings, it is reported by the research bureau of the Institute of Scrap Iron & Steel.

This estimate is based on actual returns received from companies representing 65 per cent of the total steel castings capacity of the country, the reporting companies having consumed a total of 1,159,550 tons of scrap in 1929. Total steel castings capacity is estimated at 2,097,995 tons, after eliminating plants which have long been idle.

This report is part of a survey being conducted by the research bureau of the Institute of Scrap Iron & Steel, covering scrap consumption and production during 1929. It was previously reported that the total scrap consumption during 1929 was approximately 30,000,000 gross tons, consisting of 25,000,000 tons used by the manufacturers of steel ingots and castings and 5,000,000 tons by iron foundries, blast furnaces and other miscellaneous consumers of scrap.

Although the total output of steel castings last year, as reported by the American Iron & Steel Institute, was only 1,583,040 tons, the general estimate of the trade is that the average of good castings is about 65 per cent of the total amount of steel melted. On this basis, it would have required a melting charge of 2,435,446 tons of pig iron and scrap to make the 1,583,040 tons of castings. Defective castings and sprues, heads and gates account for the loss. This material is recharged as scrap and accounts almost wholly for the home scrap of steel castings plants.

The total amount of scrap consumed by the steel castings industry is analyzed as follows:

	*Reporting Companies (tons)	†Total for Industry (tons)
Purchased in open market	702,567	1,080,872
Home scrap	456,983	703,028
Total consumption	1,159,550	1,783,900

*Representing 65 per cent of total industry. †Estimated.

An analysis of the scrap purchases of 40 steel castings companies, which purchased 270,498 tons of scrap in the open market, shows the following interesting facts:

	(tons)
Purchases from dealers	245,612
Purchased direct from producers	24,886
Total	270,498

The disposition of the above purchased scrap follows:

	(tons)
Melted in acid open-hearth furnace	148,183
Melted in electric furnaces	113,693
Melted in basic open-hearth furnaces	3,030
Unclassified	5,592
Total	270,498

The various grades of low phosphorus scrap formed a large portion of the material used in acid open hearth and in electric furnaces. Turnings also were an important item in the purchases of scrap materials.

A factor that contributes to the large consumption of scrap by the steel castings industry is the growing production of electric steel castings, for which the scrap charge in most instances is about 100 per cent. The electric steel capacity of the country last year was 528,415 tons, or more than a quarter of the total of 2,097,995 tons, while the output of electric steel castings was 419,039 tons of a total castings production of 1,583,040 tons.

Detroit Founders Meet

The regular monthly meeting of the Detroit Foundrymen's association was held at the Fort Shelby hotel, Nov. 20. The meeting was devoted to a discussion of nonferrous foundry practice. Vaughan Reid, president, City Pattern Works, Detroit, was in charge of the session. Ralph G. Raphael, sales manager, Federated Metals Corp., Chicago, gave a brief history of the development of the nonferrous foundry industry and Harry M. St. John, metallurgist, Detroit Lubricator Co., Detroit, spoke on "Brass and Bronze Metallurgy and Foundry Practice."

Purchasing Agents Meet

W. E. Humphrey, member of the federal trade commission, addressed the Purchasing Agents Association of New York, at a meeting held Nov. 18 at the Builders Exchange club, 2 Park avenue, New York. Mr. Humphrey told of the functions of the commission and particularly of its accomplishments in the past 2 years.

S. N. Ghose, one of the few original members of the revolutionary movement in India, also spoke on India as a world problem.

Chicago Founders Meet

D. M. Avey, editor, THE FOUNDRY, addressed the regular monthly meeting of the Chicago Foundrymen's association, held Dec. 4, at the City club, Chicago. Mr. Avey spoke on "Research and Researchers," covering the scope of the technical, practical and commercial fields. He told how those studies are strengthening the foundry industry's place in the march of industrial progress and named the American Foundrymen's association and affiliated groups, other research agencies and private firms which foster that work. He also suggested the possibilities of merchandising and foundry capacity analysis as fields for study.

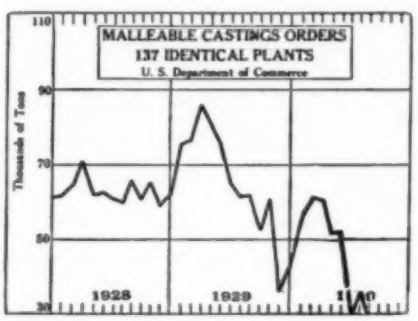
Officers for the coming year also were chosen at the meeting. L. E. Gilmore, Crane Co., Chicago, was elected president, and R. E. Kennedy, technical secretary, American Foundrymen's association, was re-elected vice president. Albert N. Wallin, S. Obermayer Co., Chicago, was re-elected secretary.

Trade Trends in Tabloid

WHILE business sentiment has improved slightly in recent weeks, production in many industries continues to decline moderately. Reports from the foundry industry show gains during November among a number of plants, although the general average of foundry operations remains at about the same level. Seasonal declines are anticipated in December, with a better demand following after the first of the year.

—T—T—

Greater interest has developed in the railway car market. Chicago, Milwaukee, St. Paul & Pacific contemplates the purchase of 4000 to 5000 cars and it is reported that the New York Central may ask for bids on from 10,000 to 15,000 cars. Awards



for November totaled 2580 cars compared with 4075 in October.

—T—T—

Average foundry operations in the Pittsburgh district show little change during the past 30 days. Iron foundries doing specialty work, particularly radiator manufacurers, enjoyed a seasonal improvement in operations during November, but schedules of other iron foundries reached the lowest level of the year. Average of gray iron foundry operations is estimated at about 25 per cent. Steel foundries have increased operations moderately during the past month.

—T—T—

Orders for malleable castings in October totaled 23,848 tons, compared with 26,228 tons in September and 61,164 tons in October, 1929. Production gained during October, with a total of 28,641 tons against 26,505 tons in September.

—T—T—

Foundries in the Chicago district are operating between 40 and 50 per cent. Operations of gray iron jobbing shops are spotty. Steel and malleable foundries are operating at a low rate and aluminum foundries have shown improvement in schedules.

—T—T—

Orders for commercial steel castings for October totaled 45,546 tons, compared with 49,542 tons in September.

—T—T—

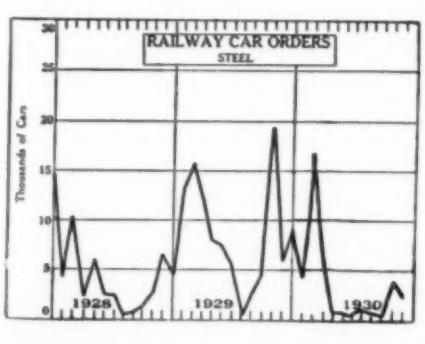
Production of gray iron foundries in October was 65.6 per cent of normal, compared with 65.7 per cent in September and 123.1 per cent in October, 1929. The district comprising the states of Wisconsin, Illinois and the area west of the Mississippi river and south to the Mexican border showed the greatest activity, according to the Gray Iron institute.

—T—T—

Another sharp drop was registered in pig iron production in November, according to *Steel*. November total production of iron was 1,865,415 tons, which was 299,959 tons or 13.8 per cent below the October level. Merchant iron production totaled 379,192 tons as compared with 414,913 tons in October.

—T—T—

Loadings of revenue freight cars



RAW MATERIAL PRICES

December 3, 1930

Iron	
No. 2 foundry, Valley	$17.00
No. 2 Southern, Birmingham	14.00
No. 2 foundry, Chicago	17.50
No. 2 foundry, Buffalo	17.50
Basic, Valley	17.00
Basic, Buffalo	17.00
Malleable, Chicago	17.50
Malleable, Buffalo	18.00
Coke	
Connellsville beehive coke	$3.50 to 4.85
Wise county beehive coke	4.50 to 5.00
Detroit by-product coke	8.50
Scrap	
Heavy melting steel, Valley	$12.50 to 13.00
Heavy melting steel, Pitts	12.50 to 13.00
Heavy melting steel, Chicago	10.00 to 10.50
Stove plate, Buffalo	9.00 to 9.50
Stove plate, Chicago	6.50 to 7.00
No. 1 cast, New York	8.00 to 8.50
No. 1 cast, Chicago	9.50 to 10.00
No. 1 cast, Philadelphia	12.50 to 13.00
No. 1 cast, Pittsburgh	12.50 to 13.00
No. 1 cast, Birmingham	11.50 to 12.00
Car wheels, iron, Pittsburgh	13.50 to 14.00
Car wheels, iron, Chicago	11.50 to 12.00
Railroad malleable, Chicago	12.00 to 12.50
Agricultural mal., Chicago	11.00 to 11.50
Malleable, Buffalo	13.00 to 13.50
Nonferrous Metals	**Cents per pound**
Casting, copper, refinery	11.25
Electro, copper, producers	12.00 to 12.12½
Straits, tin	25.80 to 25.85
Aluminum, No. 12, producers	22.00
Aluminum, No. 12 remelt	12.50
Lead, New York	5.10
Antimony, New York	7.10 to 7.12½
Nickel, electro	35.00
Zinc, East St. Louis, Ill.	4.07½ to 4.10

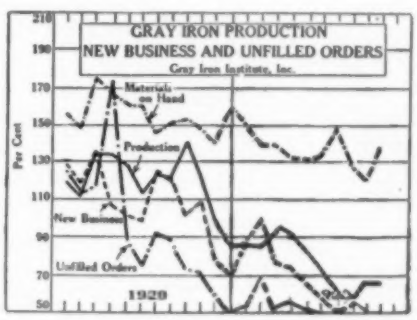
757 cars, compared with 829,251 cars the preceding week and 949,716 cars the corresponding week in 1929.

—T—T—

Production among various classes of foundries in the Philadelphia federal reserve district varied greatly during October. Gray iron shops increased production over September, the increase being confined largely to plants in Philadelphia. The tonnage of malleable iron produced, although less than in the previous month, was greater than the corresponding period in 1926, 1927, 1928, 1929. Output of steel foundries increased.

—T—T—

Foundries making stove castings in the St. Louis district reported an for the week ended Nov. 22 was 779,-



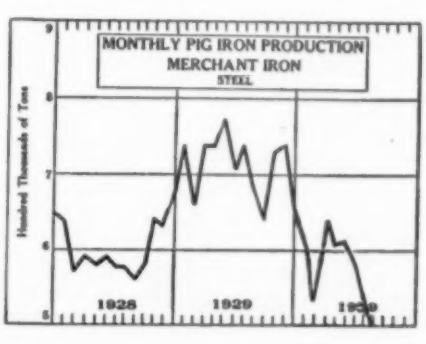
increase in orders, during the first half of November. Jobbing shops report a slight increase in demand.

—T—T—

According to a recent report of the Steel Founders Society of America, 62.5 per cent of member companies reporting are operating below 50 per cent of capacity, 23.4 per cent are operating between 50 and 70 per cent, 7.9 per cent between 70 and 99 per cent and 6.2 per cent over 100 per cent of capacity.

—T—T—

Average New York prices of nonferrous metals during November, according to *Daily Metal Trade*, were as follows: Casting copper, 10.163c; electrolytic copper 10.370c; Straits tin, 25.929c; lead, 5.100c; antimony, 7.126c; aluminum, 98-99, 22.90c. Zinc averaged 4.277c East St. Louis, Ill.



What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

J. A. Spencer Foundry & Machine Works, Dwight, Ill., has been sold.

The Hubbard, O., plant of the Valley Mould & Iron Co., has resumed operations.

J. D. Kilgore Metal Products Co., Newcomerstown, O., has resumed operations.

Pelliter Brass Foundry, 71 Loring avenue, Salem, Mass., has been closed and the equipment is being sold.

Homer Furnace Co., Coldwater, Mich., is operating day and night shifts 7 days per week. The company has been operating on a 4-day per week schedule.

Detroit Brass & Malleable Works, 1177 Holden avenue, Detroit, has increased its capital from $1,650,000 to $2,350,000.

Western Malleables Inc., Beaver Dam, Wis., recently began operating another furnace which will increase production from 20 to 50 tons per day.

Titus Foundry, Coldwater, Mich., is operating its foundry on a 24-hour basis. Sufficient orders are on hand to operate the remainder of the year.

Wilson Foundry & Machine Co., Pontiac, Mich., has resumed operations and has recalled 1800 men. D. R. Wilson is general manager.

Sanford-Day Iron Works, 612 Dale avenue, Knoxville, Tenn., is enjoying as good if not better business than in 1929, according to a recent report.

Milwaukee Flush Valve Co., 111 Reservoir avenue, Milwaukee, is taking bids for the erection of a 1-story plant addition, 22 x 40-feet. Julius Judell is president.

It is reported that contrary to recent information, the Bremen, Ind., plant of the American Radiator Co., New York, will not be moved from that city. (Noted Dec. 1.)

Canada Iron Foundries Ltd., Stuart street west, Hamilton, Ont., Can., will include a bay, 50 x 50 for a furnace, in its new foundry. The new building is 90 x 140 feet and will cost $100,000. (Noted Nov. 1.)

Henry Haupt, Huntsville, Ala., recently moved his foundry business into a new building. Mr. Haupt is manager and operates a jobbing shop for the production of gray iron, brass and aluminum castings.

Bessemer Tile & Pipe Co. Ltd., Buffalo, has secured a site at Calgary, Alta., and proposes to erect a plant for the manufacture of cast iron pipe, pipe fittings and water pipe up to 6-inch diameter.

Buckeye Foundry Co., 2257 Buck street, Cincinnati, is reported to have let the contract to B. Meniken & Son, 2143 Bernard street, for a 1-story foundry, 120 x 280 feet, to be built on Beekman street.

S. L. DeSanno, 4337 East Tenth street, Oakland, Calif., proposes to build a 1-story machine shop and brass foundry, 90 x 110 feet, at Pereita and Nineteenth streets. The cost is estimated at $40,000.

Manhattan Foundry & Model Co. Inc., 560 West Twenty-sixth street, New York, has begun operations. The company will manufacture brass, bronze and aluminum castings. P. A. Fortomaroff is president.

Mascot Stove Mfg. Co., Twenty-fifth and Chestnut streets, Chattanooga, Tenn., recently was damaged by fire. The principal damage was confined to the mounting room and warehouse. J. F. James is president of the company and O. T. Tindell is general manager.

City officials of Imlay City, Mich., are in contact with a manufacturer reported to be the Gratiot Foundry Co., which will open a foundry on Almont avenue. The company will manufacture brass and bronze tablets and brass bushings.

Joseph W. Hays Corp., 1048 East Eighth street, Michigan City, Ind., is arranging for the acquisition of land for the construction of an addition, 36 x 66 feet, into which the company's foundry will be moved. The interior of the main plant will be rearranged. Phillip Sprague is manager.

The name of the American Metal Products Co., Thirty-fourth and Burnham streets, Milwaukee, has been changed to Ampco Metal Inc. The capital of the company has been increased from $400,000 to $500,000. The company recently opened a new centrifugal casting plant.

Warren Pipe Co. of Massachusetts Inc., Everett, Mass., has started production of cast pipe in its new plant, using the sand-spun process. The company is a subsidiary of the Warren Foundry & Pipe Co., Phillipsburg, N. J. The new plant has a site of 10 acres. Four buildings have been erected.

The foundry of the Rassman Mfg. Co., Beaver Dam, Wis., recently was damaged by fire to the extent of $9,000. Damage was confined to the molding shop. The company will rebuild the damaged foundry building which is 42 x 146 feet. The cupola will be removed from the main foundry and housed in a separate building of fireproof construction. Rebuilding operations are in charge of the Hutter Construction Co., Beaver Dam.

A. H. Tallman, for many years president and manager, Tallman Brass & Metal Co., Sanford avenue and Wilson street, Hamilton, Ont., Can., is forming a company to manufacture bronze and aluminum castings, babbitt metals, etc. Joseph Medley and George McKnight are associated with him. Mr. Medley will be foundry superintendent and Mr. McKnight, sales manager. The new company has leased the P. B. Yates foundry, Cavell avenue, Hamilton, Ont. The foundry is 90 x 200 feet and is well equipped with foundry machinery for the manufacture of castings.

New Trade Publications

TRAMRAIL — Value of tramrail equipment in handling materials and parts in the automotive industry is the subject of a bulletin by the Cleveland Electric Tramrail division of the Cleveland Crane & Engineering Co., Wickliffe, O. Applications of its equipment to various uses are illustrated.

MATERIAL HANDLING EQUIPMENT—A folder by the Truscon Steel Co., pressed steel division, Cleveland, calls attention to savings made possible in materials handling by use of the company's allsteel boxes, skid platforms and factory trucks.

OIL BURNERS — Hauck Mfg. Co., Brooklyn, N. Y., manufacturer of oil-burning appliances, has issued a bulletin on its venturi atomizing low pressure oil burner, designed for use with preheated or recuperated air with or without automatic temperature control.

CONVEYOR OVENS—Despatch Oven Co., 622-628 Ninth street, southeast, Minneapolis, has issued a folder, bulletin No. 10, featuring new oven and conveyor engineering methods, designs and applications. Typical installations are pictured and the services offered by the company described.

METAL HEATER—Savings in heat by the use of electric devices is illustrated in a circular by the American Car & Foundry Co., New York, in which is described the Berwick electric metal heater. Illustrations show various types of these heaters and data tables are given.

CRANES—Bedford Foundry & Machine Co. Inc., Bedford, Ind., has issued a bulletin showing how production may be increased and materials may be handled more cheaply by the use of cranes.

ROLLER BEARINGS—Shafer Bearing Corp., Chicago, in a current catalog lists a wide range of stock mountings of its roller bearings adaptable to machine and industrial applications. It includes the recently increased range of types and sizes. The self-aligning principle is explained.

PATTERNS—Bryant Pattern & Mfg. Co., Windsor, Ont., has printed a folder as an introductory message describing the services offered by the company in wood and metal patterns, nonferrous castings, and general machine work on dies, jigs, fixtures and special machines.

UNIT HEATERS AND RADIATION —Wolverine Tube Co., Detroit, has put into a loose-leaf binder a series of bulletins on its unit heaters and ventilating devices adapted to industrial application. Illustrations and tables of data supplement the text and graphs show results of operation in heating spaces.

Sectional view of Vulcanite Wheel showing dove-tailed iron center.

How Much Are Wasted Stubs Costing YOU?

You've probably never figured it out, but it is a fact that when a solid grinding wheel wears down to 50% of its original size it is usually no longer efficient and must be discarded.

Vulcanite wheels with iron centers eliminate this waste and permit productive grinding from 95% of the wheel. The wheel displacement of the iron center is a direct saving to you. Furthermore, the iron center may be used over and over again. The elimination of flanges offers additional advantages in deep slot grinding, allowing the wheel to reach a greater depth.

Vulcanite Wheels are bonded with rubber and permit exceptionally high working speeds (8,000 to 10,000 F. P. M.) with safety.

Use Vulcanite Rubber Bonded Wheels Especially for:

High Speed Grinding
On all high tensile strength metals

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Snagging, Roughing and Cleaning
For exceptionally high production on steel alloy castings.

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Vulcanite Wheels are the acknowledged superior for regulating or feeding on centerless grinders.

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ABRASIVE WHEELS
New York Belting & Packing Co., 91 Chambers St., New York City.
Safety Grinding Wheel & Machine Co., Springfield, O.

ABRASIVES—Metallic Sandblast
American Steel Abrasives Co., Galion, O.
Globe Steel Abrasive Co., Dept. F., Mansfield, O.
Sly, W. W., Mfg. Co., 4702 Train Ave., Cleveland, O.
Steelblast Abrasives Co., Cleveland, O.

ACETYLENE DISSOLVED or in Cylinders
Prest-O-Lite Co., Inc., 30 E. 42nd St., New York City.

ACETYLENE GENERATING APPARATUS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

AIR COMPRESSORS
Bury Compressor Co., 1746 Cascade St., Erie, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
Spencer Turbine Co., Hartford, Conn.

AIR CONDITIONING Equipment
Drying Systems, Inc., 1801 Foster Ave., Chicago, Ill.

AIR SEPARATORS—See Separators—Air, Moisture, Oil

AIR TOOLS—See Tools—Pneumatic

ALKALI
Mathieson Alkali Works, Inc., The, 250 Park Ave., New York City.

ALLOYS
Electro Metallurgical Sales Corp., 30 E. 42nd St., New York City.
Titanium Alloy Mfg. Co., Niagara Falls, N. Y.

ALUMINUM
British Aluminium Co., 122 E. 42nd St., New York City.

ALUMINUM—Alloys and Ingots
British Aluminum Co., 122 E. 42nd St., New York City.

ANNEALING OVENS—See Ovens—Annealing

ARCHITECTS—Industrial
Austin Co., The, 16112 Euclid Ave., Cleveland, O.

ARRESTORS & COLLECTORS—Dust—See Dust Arresting and Collecting Systems

BABBITT METAL
Ajax Metal Co., 46 Richmond St., Philadelphia, Pa.

BAND SAWS—See Saws—Metal Band

BARS—Iron and Steel
Bethlehem Steel Co., Bethlehem, Pa.

BEARINGS—Crane
Hyatt Roller Bearing Co., Harrison, N. J.

BEARINGS—Hoist
Hyatt Roller Bearing Co., Harrison, N. J.

BEARINGS—Roller
Hyatt Roller Bearing Co., Harrison, N. J.

BEARINGS—Steel Mill Equipment
Hyatt Roller Bearing Co., Harrison, N. J.

BEARINGS—Trolley
Hyatt Roller Bearing Co., Harrison, N. J.

BELLOWS—Molders
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.

BELTING—Conveyor
New York Belting & Packing Co., 91 Chambers St., New York City.

BINDERS—See Core Binders

BINS—Steel Storage
Erie Steel Construction Co., Erie, Pa.

BLACKING MIXTURE
Stevens, Frederic B., Inc., Larned and Third St., Detroit, Mich.

BLAST METERS
Bacharach Industrial Instrument Co., 7000 Bennett St., Pittsburgh, Pa.

BLOCKS—Chain
Box Crane & Hoist Corp., 2226 Ontario St., Philadelphia Pa.
Yale & Towne Mfg. Co., The, Stamford, Conn.

BLOWERS
Ingersoll-Rand Co., 11 Broadway, New York City.
Knickerbocker Co., The, Jackson Mich.
Spencer Turbine Co., Hartford, Conn.

BLUE POTS—Patternshop
General Electric Co., Schenectady.

BOLTS AND NUTS
Bethlehem Steel Co., Bethlehem, Pa.

BOND—Molding Sand
Great Lakes Foundry Sand Co., Penobscot Bldg., Detroit, Mich.

BOOKS—Technical
Penton Publishing Co., Cleveland.

BOTTOM PLATES—Steel
Shanafelt Mfg. Co., Canton, O.
Truscon Steel Co. (Pressed Steel Div.), 6114 Truscon Ave., Cleveland, O.

BRICK—Refractory
Corundite Refractories, Inc., 920 Duquesne Way, Pittsburgh, Pa.

BRONZE—Manganese
Ajax Metal Co., 46 Richmond St., Philadelphia, Pa.

BRUSHES
General Electric Co., Schenectady, N. Y.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.

BRUSHES—Motor and Generator
United States Graphite Co., Saginaw, Mich.

BRUSHES—Wire
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BUCKET LOADERS FOR Sand Mills
National Engineering Co., 549 W. Washington Blvd., Chicago, Ill.

BUCKETS
Penn Foundry & Mfg. Co., Reading, Pa.

BUCKETS—Clamshell, Dragline, Grab
Brosius, Edgar E., 19th St. & P R. R., Sharpsburg P. O., Pittsburgh, Pa.
Erie Steel Construction Co., Erie, Pa.
Harnischfeger Corp., 3800 National Ave., Milwaukee, Wis.
Williams, G. H., Co., 611 Haybarger Lane, Erie, Pa.

BUCKETS—Electric
Erie Steel Construction Co., Erie, Pa.

BUFFING COMPOSITIONS
Stevens, Frederic B., Inc., Larned and Third St., Detroit, Mich.

BUILDINGS—Foundry, Factory, Industrial
Austin Co., The, 16112 Euclid Ave., Cleveland, O

BURNERS—Acetylene—See Torches and Burners—Acetylene, Blow, Oxy-Acetylene

BURNERS—Oil or Gas
Foundry Equipment Co., The, 1831 Columbus Rd., Cleveland, O
Hauck Manufacturing Co., 126 Tenth St., Brooklyn, N. Y.

BUSHINGS—Flask Pins
Michigan Screw Co., Lansing, Mich.

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CALCIUM—MANGANESE—SILICON
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CALCIUM—SILICON
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Union Carbide Sales Co., 30 E. 42nd St., New York City.

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Bethlehem Steel Co., Bethlehem, Pa.
Foundry Equipment Co., The, 1831 Columbus Rd., Cleveland, O.
Northern Engineering Works, 210 Chene St., Detroit, Mich.
Penn Foundry & Mfg. Co., Reading, Pa.

CARS—Sandblast
Sly, W. W., Mfg. Co., 4700 Train Ave., Cleveland, O.

CARS & Locomotives—Industrial
Industrial Equipment Co., The, Minster, O.

CASTINGS—Gray Iron
Bethlehem Steel Co., Bethlehem, Pa.
Manning, Maxwell, Moore, Inc., 100 E. 42nd St., New York City.

CEMENT—Fire Brick
Corundite Refractories, Inc., 920 Duquesne Way, Pittsburgh, Pa.

CEMENT—Furnace
Alpha Lux Co., Inc., 192 Front St., New York, N. Y.
Corundite Refractories, Inc., 920 Duquesne Way, Pittsburgh, Pa.
Dixon, Joseph, Crucible Co., Jersey City, N. J.

CEMENT—High Temperature
Alpha Lux Co., Inc., 192 Front St., New York, N. Y.
Corundite Refractories, Inc., 920 Duquesne Way, Pittsburgh, Pa.

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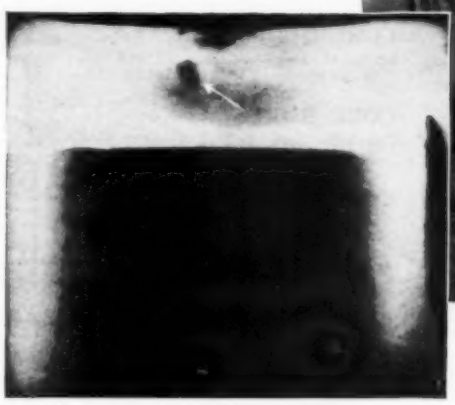

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Sly, W. W., Mfg. Co., 4702 Train Ave., Cleveland O

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Tabor Mfg. Co., The, 6225 Tacony St., Philadelphia.

CLAMPS—Flask

Tabor Mfg. Co., The, 6225 Tacony St., Philadelphia.

CLAMPS—Hose—See Hose Clamps

CLAY—Fire—See Fire Clay

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Hillman Coal & Coke Co., First Nat'l Bank Bldg., Pittsburgh.

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Harnischfeger Corp., 3800 National Ave., Milwaukee, Wis.

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Hanna Furnace Corp., The, Detroit, Mich.
Hillman Coal & Coke Co., First Nat'l Bank Bldg., Pittsburgh.
Stevens, Frederic B., Inc., Larned and Third Sts., Detroit, Mich.

COMPRESSORS—Air—See Air Compressors

CONDENSERS—Surface, Barometric & Low Level Jet

Ingersoll-Rand Co., 11 Broadway, New York City.

CONSTRUCTION—Foundry Building—See Buildings—Foundry, Factory, Industrial

CONTRACTORS—See Engineers and Contractors

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Beardsley & Piper Co., 2541 N. Keeler Ave., Chicago, Ill.
Jeffrey Mfg. Co., The, Columbus, O.
Mathews Conveyer Co., 104 Tenth St., Ellwood City, Pa.
National Engineering Co., 549 W. Washington St., Chicago.
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Knefler-Bates Co., Indianapolis, Ind.
Pennsylvania Lubricating Co., 34th & Smallman Sts., Pittsburgh.
Smith, Werner G., Co., 2191 W. 110th St., Cleveland.
Stevens, Frederic B., Inc., Larned and Third Sts., Detroit, Mich.

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Demmler, Wm., & Brothers, Kewanee, Ill.
Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh.
International Molding Machine Co., 2616 W. 16th St., Chicago, Ill.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.
Tabor Mfg. Co., The, 6225 Tacony St., Philadelphia.

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Smith, Werner G., Co., 2191 W. 110th St., Cleveland, O.
Stevens, Frederic B., Inc., Larned and Third Sts., Detroit, Mich.

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Foundry Equipment Co., The, 1831 Columbus Rd., Cleveland, O.
Gehnrich Oven Co., Inc., Skillman Ave.-36th St., Long Island City, N. Y.
Holcroft & Co., 6545 Epworth Blvd. Detroit, Mich.
Stevens, Frederic B., Inc., Larned and Third Sts., Detroit, Mich.
Young Brothers Co., 6508 Mack Ave., Detroit, Mich.

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CORE REDUCERS

National Engineering Co., 549 W. Washington Blvd., Chicago, Ill.

CORE RODS

Franklin Core Rod & Gagger Co., Franklin, Pa.

CORE ROD STRAIGHTENING & CUTTING MACHINES

American Foundry Equipment Co., 400 Byrkit Ave., Mishawaka, Ind.

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Truscon Steel Co. (Pressed Steel Div.), 6114 Truscon Ave., Cleveland, O.

CORE SAND MIXERS

National Engineering Co., 549 W. Washington Blvd., Chicago, Ill.

CORE WASH

Dixon, Jos., Crucible Co., Jersey City, N. J.

CRANES

Conco Crane & Engineering Works, Div. of H. D. Conkey Co., Mendota, Ill.
Erie Steel Construction Co., Erie, Pa.
Euclid Crane & Hoist Co., The, Euclid, Ohio.
Harnischfeger Corp., 3800 National Ave., Milwaukee, Wis.
Modern Pouring Device Co., Port Washington, Wis.

CRANES—Bucket

Euclid Crane & Hoist Co., The, Euclid, Ohio.
Harnischfeger Corp., 3800 National Ave., Milwaukee, Wis.

CRANES—Electric

Box Crane & Hoist Corp., 2226 Ontario St., Philadelphia, Pa.
Euclid Crane & Hoist Co., The, Euclid, Ohio.
Harnischfeger Corp., 3800 National Ave., Chicago, Ill.
Manning, Maxwell & Moore Inc., 100 E. 42nd St., New York City.
Northern Engineering Works, 210 Chene St., Detroit, Mich.
Scully-Jones & Co., 19th & Rockwell Sts., Chicago, Ill.
Whiting Corp., Harvey, Ill.

CRANES—Gantry

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Manning, Maxwell & Moore, Inc., 100 E. 42nd St., New York City.
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CRANES—Hand

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Harnischfeger Corp., 3800 National Ave., Milwaukee, Wis.
Modern Pouring Device Co., Port Washington, Wis.
Northern Engineering Works, 210 Chene St., Detroit, Mich.
Scully-Jones & Co., 19th & Rockwell Sts., Chicago, Ill.
Yale & Towne Mfg. Co., The, Stamford, Conn.

CRANES—Jib

Harnischfeger Corp., 3800 National Ave., Milwaukee, Wis.
Modern Pouring Device Co., Port Washington, Wis.
Northern Engineering Works, 210 Chene St., Detroit, Mich.
Scully-Jones & Co., 19th & Rockwell Sts., Chicago, Ill.
Yale & Towne Mfg. Co., The, Stamford, Conn.

CRANES—Monorail

Euclid Crane & Hoist Co., The, Euclid, Ohio.
Harnischfeger Corp., 3800 National Ave., Chicago, Ill.
Modern Pouring Device Co., Port Washington, Wis.

CRANES—Overhead

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Euclid Crane & Hoist Co., The, Euclid, Ohio.
Harnischfeger Corp., 3800 National Ave., Milwaukee, Wis.
Modern Pouring Device Co., Port Washington, Wis.
Yale & Towne Mfg. Co., The, Stamford, Conn.

CRANES—Tramrail

Modern Pouring Device Co., Port Washington, Wis.

CRANE—Wall

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Modern Pouring Device Co., Port Washington, Wis.

CRUCIBLE LIFTERS

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Modern Pouring Device Co., Port Washington, Wis.

CRUCIBLE POURING DEVICES

Modern Pouring Device Co., Port Washington, Wis.

CRUCIBLES

Corundite Refractories, Inc., 920 Duquesne Way, Pittsburgh, Pa.
Dixon, Jos., Crucible Co., Jersey City, N. J.
Ross-Tacony Crucible Co., Tacony, Philadelphia, Pa.

CRUSHED STEEL—See Steel—Crushed

CUPOLA BLOCKS

Corundite Refractories, Inc., 920 Duquesne Way, Pittsburgh, Pa.

CUPOLA BLOWERS

Spencer Turbine Co., Hartford, Conn.

CUPOLA BRICK

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CUPOLA CHARGING Machines—Electric

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Euclid Crane & Hoist Co., The, Euclid, Ohio.

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CUTTING AND WELDING —Oxy-Acetylene—See Welding and Cutting Apparatus and Supplies—Oxy-Acetylene

CUTTING & WELDING EQUIPMENT — Electric ARC—See Welding & Cutting Equipment

CYLINDERS—Acetylene—See Acetylene Dissolved

CYLINDERS—Oxygen—See Oxygen in Cylinders

DEOXIDIZERS

Titanium Alloy Mfg. Co.,
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DESULPHERIZER

Mathieson Alkali Works, Inc., The,
250 Park Ave., New York City.

DOWEL PINS—Brass, Iron, Wood

Shanafelt Mfg. Co., Canton, O.

DRILLS—Pneumatic

Chicago Pneumatic Tool Co.,
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Ingersoll-Rand Co.,
11 Broadway, New York City.

DRUMS—Magnetic

Magnetic Mfg. Co.,
278-23rd Ave., Milwaukee, Wis.

DRYERS—Sand—See Sand Dryers

DRYING MACHINES & APPARATUS

Ransohoff, N., Inc., W. 71st and Mill Creek, Carthage, Cincinnati.

DUST ARRESTING and Collecting Systems

American Foundry Equipment Co.,
400 Byrkit Ave., Mishawaka, Ind.
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Jackson, Mich.
New Haven Sand Blast Co.,
New Haven, Conn.
Parsons Engineering Co.,
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ENGINEERS—Foundry Mechanical, Electrical, etc.

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Bartlett, C. O., & Snow Co., 6201 Harvard Ave., Cleveland, O.
Beardsley & Piper Co., t2541 N. Keeler Ave., Chicago, Ill.
Hunt, Robert W., Co.,
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Jeffrey Mfg. Co., The, Columbus, O.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.
Sly, W. W., Mfg. Co.,
4702 Train Ave., Cleveland, O.

ENGINES—Oil, Gas

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EXHAUST SYSTEMS

American Foundry Equipment Co.,
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EYE PROTECTORS—See Goggles and Eye Protectors

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FACINGS

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FERROMANGANESE

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Electro Metallurgical Sales Corp.,
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Foundry Manganese Co., 208 Harrison Bldg., Philadelphia, Pa.

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Electro Metallurgical Sales Corp.,
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Foundry Manganese Co., 208 Harrison Bldg., Philadelphia, Pa.

FILLETS—Leather, Wood

Shanafelt Mfg. Co., Canton, O.

FILMS—X-Rays

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FIRE BRICK AND CLAY

Corundite Refractories, Inc., 920 Duquesne Way, Pittsburgh, Pa.
Stevens, Frederic B., Inc., Larned and Third Sts., Detroit, Mich.

FIRE CLAY

Corundite Refractories, Inc., 920 Duquesne Way, Pittsburgh, Pa.
Great Lakes Foundry Sand Co.,
Penobscot Bldg., Detroit, Mich.

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Michigan Screw Co., Lansing, Mich.

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American Foundry Equipment Co.,
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Freeport, Ill.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.
Shanafelt Mfg. Co., Canton, O.
Tabor Mfg. Co., The,
6225 Tacony St., Philadelphia.
Truscon Steel Co. (Pressed Steel Div.), 6114 Truscon Ave.,
Cleveland, O.

FLOODLIGHTS—Acetylene

Oxweld Acetylene Co.,
30 E. 42nd St., New York City.

FLOUR—Foundry

Knefler-Bates Co., Indianapolis, Ind.

FLUX, IRON, BRASS, STEEL, COPPER, ALUMINUM

Mathieson Alkali Works, Inc., The,
250 Park Ave., New York City.

FORGINGS — Pressed & Drop

Bethlehem Steel Co., Bethlehem, Pa.

FOUNDRY AND FACTORY Buildings—See Buildings—Foundry, Factory, Industrial

FOUNDRY ENGINEERS—See Engineers—Foundry, Mechanical, Electrical, etc.

FOUNDRY EQUIPMENT—Second Hand

Scully-Jones & Co., 19th & Rockwell Sts., Chicago, Ill.

FOUNDRY SPECIALISTS —Consulting

Austin Co., The,
16112 Euclid Ave., Cleveland, O.
Beardsley & Piper Co., 2541 N. Keeler Ave., Chicago, Ill.
Jeffrey Mfg. Co., The, Columbus, O.
Osborn Mfg. Co.,
5401 Hamilton Ave., Cleveland, O.
Sly, W. W., Mfg. Co.,
4700 Train Ave., Cleveland, O.
Vickers, Charles,
110 Main St., Buffalo, N. Y.

FOUNDRY SUPPLY Houses

Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.
Stevens, Frederic B., Inc., Larned and Third Sts., Detroit, Mich.

FURNACE LININGS

Corundite Refractories, Inc., 920 Duquesne Way, Pittsburgh, Pa.

FURNACES—Crucible

Foundry Equipment Co., 1831 Columbus Rd., Cleveland, O.

FURNACES—Electric Melting

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Detroit Electric Furnace Co.,
825 W. Elizabeth St.,
Detroit, Mich.
Foundry Equipment Co., 1831 Columbus Rd., Cleveland, O.
Greene Electric Furnace Co.,
1918-1st Ave., So. Seattle, Wash.
Pittsburgh Electric Furnace Corp.,
32nd St. & Putney Way,
Pittsburgh, Pa.
Stevens, Frederic B., Inc., Larned and Third Sts., Detroit, Mich.
Swindell-Dressler Corp.,
P. O. Box 1753, Pittsburgh, Pa.

FURNACES—Melting—Aluminum and Brass

Fisher, Alfred, Furnaces, Inc.,
762 West Adams St., Chicago, Ill.
Foundry Equipment Co., 1831 Columbus Rd., Cleveland, O.
Pittsburgh Electric Furnace Corp.,
32nd St. & Putney Way,
Pittsburgh, Pa.
Stevens, Frederic B., Inc., Larned and Third Sts., Detroit, Mich.

FURNACES—Open Hearth

Swindell-Dressler Corp.,
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GAGGERS

Franklin Core Rod & Gagger Co.,
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United Compound Co.,
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GASKETS—Rubber & Asbestos

New York Belting & Packing Co.,
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Jones, W. A., Foundry & Machine Co., 4401 W. Roosevelt Rd., Chicago, Ill.

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4700 Train Ave., Cleveland, O.

GRAPHITE

Dixon, Jos., Crucible Co.,
Jersey City, N. J.
United States Graphite Co., The,
Saginaw, Mich.

GRAPHITE—Boiler and Lubricating

United States Graphite Co.,
Saginaw, Mich.

GRINDERS—Electric Portable

Cincinnati Electrical Tool Co.,
2678 Madison Rd., Cincinnati, O.

GRINDERS—Pneumatic Portable

Cincinnati Electrical Tool Co.,
2678 Madison Rd., Cincinnati, O.
Cleveland Pneumatic Tool Co.,
3734 E. 78th St., Cleveland, O.
Ingersoll-Rand Co.,
11 Broadway, New York City.
Rotor Air Tool Co., The,
5900 Carnegie Ave., Cleveland, O.

GRINDERS—Snagging, Motor Driven

Cincinnati Electrical Tool Co.,
2678 Madison Rd., Cincinnati, O.
Pittsburgh Engineering Works,
P. O. Box 1125, Pittsburgh, Pa.
Safety Grinding Wheel & Machine Co., Springfield, O.

GRINDING PANS—Sand

Phillips & McLaren Co., 24th and Smallman Sts., Pittsburgh, Pa.

GRINDING WHEELS—See Abrasive Wheels

GRIT—Angular and Steel

American Steel Abrasives Co.,
Galion, O.
Globe Steel Abrasive Co.,
Mansfield, O.
Patch-Wegner Co., Inc.,
Rutland, Vt.
Sly, W. W., Mfg. Co.,
4702 Train Ave., Cleveland, O.
Steelblast Abrasives Co.,
Cleveland, O.

HACK SAWS—See Saws—Hack

HAMMERS—Chipping and Riveting—Pneumatic

Cleveland Pneumatic Tool Co.,
3734 E. 78th St., Cleveland, O.
Ingersoll-Rand Co.,
11 Broadway, New York City.

HANGERS—Roller Bearing for Line Shafts

Hyatt Roller Bearing Co.,
Harrison, N. J.

HARDNESS TESTING & Heat Measuring Instruments

Shore Instrument & Mfg. Co., Inc., Van Wyck Ave. & Carll St., Jamaica, L. I., New York.

See Index to Advertisements for Pages Containing Advertisements of Companies Listed Above

Truscon Foundry Flasks do a better job of casting in quicker time and at lower costs. They are furnished in standard and special sizes to meet each requirement. Other Truscon Products for efficient foundry operation include Bottom Boards, Gaggers, Bands, Core Racks, Trays and Boxes, etc. Write for Flask catalog.

PRESSED TRUSCON & DRAWN STEEL

TRUSCON STEEL COMPANY
PRESSED STEEL DIVISION
6100 Truscon Ave., Cleveland, O.

FOUNDRY FLASKS AND ACCESSORIES

SHANAFELT

"ONE PIECE"—"ALL STEEL"

FLASKS

Shanafelt Steel Flasks are made to quality standards and every manufacturing step supervised by a thoroughly competent and experienced organization.

Cooperation with the customer in designing and building a flask that will produce castings efficiently and economically is part of our service, and is worthy of your investigation.

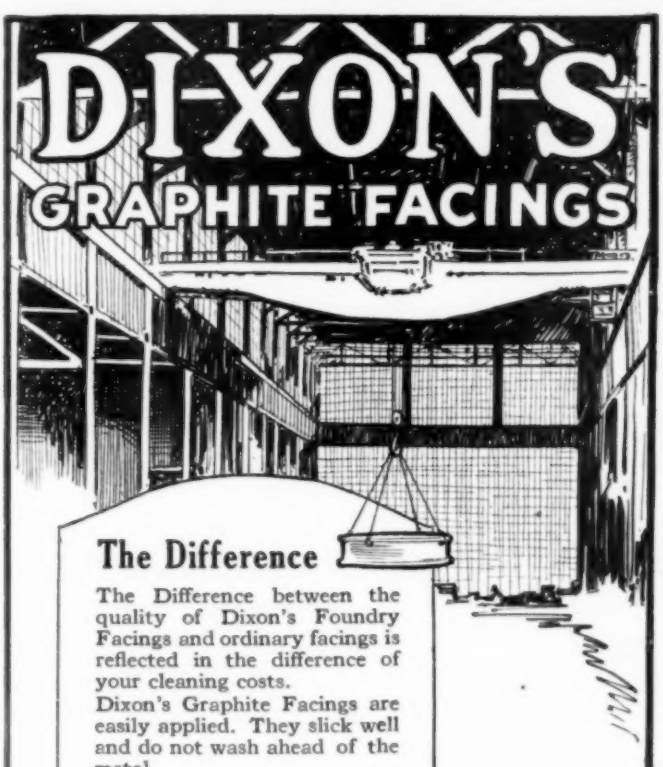
THE SHANAFELT MFG. CO., CANTON, O.

Branches:
New York City, Philadelphia, Detroit, Providence, Birmingham, Chicago, Buffalo

Several hundred of these flasks were built for a large heater manufacturer in Ohio which are producing excellent results.

"One Piece—All Steel" Shanafelt Flask designed for casting truck wheels.

DIXON'S GRAPHITE FACINGS



The Difference

The Difference between the quality of Dixon's Foundry Facings and ordinary facings is reflected in the difference of your cleaning costs.

Dixon's Graphite Facings are easily applied. They slick well and do not wash ahead of the metal.

Made in Jersey City, N. J., by the
Joseph Dixon Crucible Company
Dept. 51-S

D X N TRADE MARK *Established 1827* D X N TRADE MARK

Tell us your conditions, and we'll gladly send samples.

*IF

HARDWARE—Builders
Yale & Towne Mfg. Co., The, Stamford, Conn.

HEATERS—Industrial Ovens
Drying Systems, Inc., 1801 Foster Ave., Chicago, Ill.

HELMETS—Sandblast
American Foundry Equipment Co., 400 Byrkit Ave., Mishawaka, Ind.
Sly, W. W., Mfg. Co., 4700 Train Ave., Cleveland, O.

HOISTING MACHINERY
Euclid Crane & Hoist Co., The, Euclid, Ohio.
Harnischfeger Corp., 3800 National Ave., Milwaukee, Wis.

HOISTS—Air
Ingersoll-Rand Co., 11 Broadway, New York City.

HOISTS—Chain
Harnischfeger Corp., 3800 National Ave., Milwaukee, Wis.
Yale & Towne Mfg. Co., The, Stamford, Conn.

HOISTS—Electric
Euclid Crane & Hoist Co., The, Euclid, Ohio.
Harnischfeger Corp., 3800 National Ave., Milwaukee, Wis.
Northern Engineering Works, 210 Chene St., Detroit, Mich.
Yale & Towne Mfg. Co., The, Stamford, Conn.

HOISTS—Monorail
Euclid Crane & Hoist Co., The, Euclid, Ohio.

HOISTS—Pneumatic
Northern Engineering Works, 210 Chene St., Detroit, Mich.

HOSE—Pneumatic
New York Belting Packing Co., 91 Chambers St., New York City.

HOSE—Sandblast
American Foundry Equipment Co., 400 Byrkit Ave., Mishawaka, Ind.
New York Belting & Packing Co., 91 Chambers St., New York City.
Sly, W. W., Mfg. Co., 4700 Train Ave., Cleveland, O.

HOSE—Welding
New York Belting & Packing Co., 91 Chambers St., New York City.

HOSE COUPLINGS—Pneumatic
Cleveland Pneumatic Tool Co., 3734 E. 78th St., Cleveland, O.

INDUSTRIAL TRACTORS—See Tractor-Industrial

INGOTS—Aluminum
British Aluminium Co., 122 E. 42nd St., New York City.

INGOTS—Brass, Bronze, Copper, Nickel
Ajax Metal Co., 46 Richmond St., Philadelphia, Pa.

IRON ORE
Hanna Furnace Corp., The, Detroit, Mich.
Superior Charcoal Iron Co., Grand Rapids, Mich.

JACKETS—Snap Flask and Mold
American Foundry Equipment Co., 400 Byrkit Ave., Mishawaka, Ind.
Arcade Mfg. Co., Dept. D, Freeport, Ill.

JOLT RAMMING Machines
International Molding Machine Co., 2616 W. 16th St., Chicago, Ill.

JOLT RAMMING Machines—Pneumatic and Electric
Arcade Mfg. Co., Dept. D, Freeport, Ill.
Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh.
Johnston & Jennings Co., 877 Addison Rd., Cleveland.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.
Tabor Mfg. Co., The, 6225 Tacony St., Philadelphia.

LABORATORIES — Physical Testing
Hunt, Robert W., Co., 175 W. Jackson Blvd., Chicago, Ill.

LADLE HEATERS AND Dryers
Hauck Mfg. Co., 126 Tenth St., Brooklyn, N. Y.

LADLE LININGS
Alpha Lux Co., Inc., 192 Front St., New York, N. Y.

LADLES
Industrial Equipment Co., The, Minster, O.
Modern Pouring Device Co., Port Washington, Wis.
Northern Engineering Works, 210 Chene St., Detroit, Mich.
Stevens, Frederic B., Inc., Larned and Third Sts., Detroit, Mich.

LEAD
Stevens, Frederic B., Inc., Larned and Third Sts., Detroit, Mich.
United States Graphite Co., The, Saginaw, Mich.

LINSEED OIL
Kellogg, Spencer, & Sons Sales Corp., Niagara Square, Buffalo, N. Y.

LINSEED OIL—Core
Kellogg, Spencer, & Sons Sales Corp., Niagara Square, Buffalo, N. Y.

LINE SHAFT BEARINGS—Roller
Hyatt Roller Bearing Co Harrison, N. J.

LININGS—Monolithic
Alpha Lux Co., Inc., 192 Front St., New York, N. Y.

LINSEED OIL
Pennsylvania Lubricating Co., 34th & Smallman Sts., Pittsburgh.

LINSEED—OIL—Core
Smith, Werner G., Co., 2191 W. 110th St., Cleveland, O

LOADERS—Batch
Ransohoff, N., Inc., W. 71st and Mill Creek, Carthage, Cincinnati.

LOADERS—Portable, Belt or Bucket
Jeffrey Mfg. Co., The, Columbus, O.

LOCKS—Industrial
Yale & Towne Mfg. Co., The, Stamford, Conn.

LUBRICANTS—Industrial
Lindsay-McMillan Co., 930 S. Water St., Milwaukee, Wis

MACHINERY—Special
Bethlehem Steel Co., Bethlehem, Pa.

MAGNETIC CLUTCHES—See Clutches—Magnetic

MAGNETICS—Electro, Safety
Magnetic Mfg. Co., 278-23rd Ave., Milwaukee, Wis.

MANGANESE
Electro Metallurgical Sales Co., 30 E. 42nd St., New York City.

MANIFOLDS—Oxygen
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

METALLURGISTS
Hunt, Robert W., Co., 175 W. Jackson Blvd., Chicago, Ill.

METALS—Nonferrous
Ajax Metal Co., 46 Richmond St., Philadelphia, Pa.
Titanium Alloy Mfg. Co., The, Niagara Falls, N. Y.

MILLING STARS AND Jacks—See Stars—Tumbling Mill

MILLS—Sand Mixing and Compounding
Bartlett, C. O., & Snow Co., 6201 Harvard Ave., Cleveland, O.
National Engineering Co., 549 W. Washington Blvd., Chicago, Ill.

MIXERS—Sand—See Sand Mixers and Cutters

MOLD CONVEYORS
Bartlett, C. O., & Snow Co., 6201 Harvard Ave., Cleveland, O.
Beardsley & Piper Co., 2541 N. Keeler Ave., Chicago, Ill.
National Engineering Co., 549 W. Washington Blvd., Chicago, Ill.

MOLD OVENS & DRYERS
Drying Systems, Inc., 1801 Foster Ave., Chicago, Ill.
Foundry Equipment Co., 1831 Columbus Rd., Cleveland, O
Gehnrich Oven Co., Inc., Skillman Ave.-36th St., Long Island City, N. Y.
Holcroft & Co., 6545 Epworth Blvd., Detroit, Mich.
Young Brothers Co., 6508 Mack Ave., Detroit, Mich.

MOLDERS' SHOVELS
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.
Wood Shovel & Tool Co., The, Piqua, Ohio.

MOLDING MACHINES
Arcade Mfg. Co., Dept. D, Freeport, Ill.
Beardsley & Piper Co., 2541 N. Keeler Ave., Chicago, Ill.
Demmler, Wm., & Brothers, Kewanee, Ill.
Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh.
International Molding Machine Co., 2616 W. 16th Ct., Chicago, Ill.
Johnston & Jennings Co., 877 Addison Rd., Cleveland.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.
Tabor Mfg. Co., The, 6225 Tacony St., Philadelphia.

MOLDING MACHINES—Roll Over
Arcade Mfg. Co., Dept. D, Freeport, Ill.
Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh.
International Molding Machine Co., 2616 W. 16th St., Chicago, Ill.
Johnston & Jennings Co., 877 Addison Rd., Cleveland.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.
Tabor Manufacturing Co., 6225 Tacony St., Philadelphia, Pa.

MOLDING MACHINES—Sand Throwing
Beardsley & Piper Co., 2541 N. Keeler Ave., Chicago, Ill.

MOLDING MACHINES—Squeezer
Arcade Mfg. Co., Dept. D Freeport, Ill.
International Molding Machine Co., 2616 W. 16th St., Chicago, Ill.
Johnston & Jennings Co., 877 Addison Rd., Cleveland.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.
Tabor Mfg. Co., The, 6225 Tacony St., Philadelphia.

MOLDING SYSTEMS—Continuous
Bartlett, C. O., & Snow Co., 6201 Harvard Ave., Cleveland.
National Engineering Co., 549 W. Washington Blvd., Chicago, Ill.
Osborn Manufacturing Co., 5401 Hamilton Ave., Cleveland, O.

MONORAIL SWITCHES—and Turntables
Modern Pouring Device Co., Port Washington, Wis.
Yale & Towne Mfg. Co., The, Stamford, Conn.

NICKEL
Williams & Co., Inc., 901-37 Penn. Ave., Pittsburgh, Pa.

NIGHT LATCHES
Yale & Towne Mfg. Co., The, Stamford, Conn.

NITROGEN—Gas
Linde Air Products Co., 30 E. 42nd St., New York City.

NOZZLES—Sandblast
American Foundry Equipment Co., 400 Byrkit Ave., Mishawaka, Ind.
Mill Alloys, Inc., 3202 S. San Pedro St., Los Angeles, Cal.
Sly, W. W., Mfg. Co., 4700 Train Ave., Cleveland, O.

OIL—Core—See Core Oil

OIL & GAS BURNING Systems
Drying Systems, Inc., 1801 Foster Ave., Chicago, Ill.
Foundry Equipment Co., The, 1831 Columbus Rd., Cleveland, O.
Hauck Mfg. Co., 126 Tenth St., Brooklyn, N. Y.

OVENS—Annealing
Gehnrich Oven Co., Inc., Skillman Ave.-36th St., Long Island City, N. Y.

OVENS—Core—See Core Ovens

OVENS—Enameling, Japanning, etc.
Drying Systems, Inc., 1801 Foster Ave., Chicago, Ill.
Foundry Equipment Co., 1831 Columbus Rd., Cleveland, O.
Gehnrich Oven Co., Inc., Skillman Ave.-36th St., Long Island City, N. Y.
Maehler, Paul, Co., The, 2210 West Lake St., Chicago, Ill.
Young Brothers Co., 6508 Mack Ave., Detroit, Mich.

OVENS—Gas, Oil or Electric
Drying Systems, Inc., 1801 Foster Ave., Chicago, Ill.
Gehnrich Oven Co., Inc., Skillman Ave.-36th St., Long Island City, N. Y.

OVENS—Mold—See Mold Ovens

OXY-ACETYLENE EQUIPMENT—See Welding and Cutting Apparatus and Supplies—Oxy-acetylene

OXY-ACETYLENE WELDING and Cutting—See Welding and Cutting Apparatus and Supplies—Oxy-Acetylene

OXYGEN IN CYLINDERS
Linde Air Products Co., 30 E. 42nd St., New York City.

PACKING—Sheet
New York Belting & Packing Co., 91 Chambers St., New York City.

See Index to Advertisements for Pages Containing Advertisements of Companies Listed Above

This Dust Collector Lasts!

RUGGED ALL-METAL CONSTRUCTION
NO MOVING PARTS

MORSE Rarefied Dust Collector

For more than twenty years the Morse has filled the need for an efficient and low cost means of providing clean foundry air.

There's nothing to get out of order—no screens to clog up or cut through—no cutting out of fan.

Write for full particulars.

The Knickerbocker Co.
516 Liberty St., Jackson, Mich.

Approved by 260 Plants

This Core Machine Increases Production.

We build Core Machines to suit your conditions.

Gas Stove Burners.
Plumbing Goods.
Intricate Cores

Correspondence Solicited

Wm. Demmler & Bros.
Kewanee, Ill.

Quality Unrivalled is Packaged in Plaid!

Hack saw blades—band saws—screw drivers—glasscutters—good mechanics the country over are sure of uniform high quality when they ask for

"The Tools in the Plaid Box"

AMERICAN SAW & MFG. COMPANY
Springfield, Mass.

LENOX

Turning Used Molding Sand Into Gold Dollars

The sand that foundries have been discarding as worthless can be made as efficient as when new—over and over again—at very low cost—by renewing its efficiency with

RENEWO BOND

(Made exclusively of Pennsylvania high grade fire clays)

THIS practice greatly reduces molding cost by making a little sand go a long way. The savings in freight, handling and storing are tremendous.

RENEWO Bond gives the three real necessities in sand—POROSITY — PERMEABILITY — DURABILITY. In fact, it improves nature's product.

A noted foundry authority says "your deposits are the finest I have ever seen" (name on request).

Try RENEWO Bond! We will mix your clays to your exact specifications. Why shop around?

Renewo Clay Products, Inc.
Phone 6845 ***Ridgway, Pa.***
Works: **Hutchins, McKean County, Pa.**

PADLOCKS
Yale & Towne Mfg. Co., The, Stamford, Conn.

PAINT—GRAPHITE
United States Graphite Co., The, Saginaw, Mich.

PANS—Grinding—See Grinding Pans—Sand

PANS—Tempering
National Engineering Co., 549 W. Washington Blvd., Chicago, Ill.
Phillips & McLaren Co., 24th and Smallman Sts., Pittsburgh, Pa.

PARTING COMPOUNDS
American Foundry Equipment Co., 400 Byrkit Ave., Mishawaka, Ind.
Stevens, Frederic B., Inc., Larned and Third Sts., Detroit, Mich.

PATTERN LETTERS
Shanafelt Mfg. Co., Canton, O.

PATTERN WAX
United Compound Co., 228 Elk St., Buffalo, N. Y.

PATTERNS—Wood, Metal
Arcade Mfg. Co., Dept. D, Freeport, Ill.
Bascom & Co., River & Hoosick Sts., Troy, N. Y.
Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh.

PHOTOMICROGRAPHIC Plates
Eastman Kodak Co., Rochester.

PICKLING MACHINES
Ransohoff, N., Inc., W. 71st and Mill Creek, Carthage, Cincinnati.

PIG IRON
Bethlehem Steel Co., Bethlehem, Pa.
Hanna Furnace Corp., The, Detroit, Mich.
Pilling & Co., Inc., 1500 Chestnut St., Philadelphia, Pa.
Superior Charcoal Iron Co., Grand Rapids, Mich.

PINS—Flask
Michigan Screw Co., Lansing, Mich.

PLATES—Rapping
Shanafelt Mfg. Co., Canton, O.

PLUMBAGO
Dixon, Jos., Crucible Co., Jersey City, N. J.
Stevens, Frederic B., Inc., Larned and Third Sts., Detroit, Mich.
United States Graphite Co., Saginaw, Mich.

PNEUMATIC TOOLS—See Tools—Pneumatic

POLISHERS' AND Platers' Supplies
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.
Stevens, Frederic B., Inc., Larned and Third Sts., Detroit, Mich.

PORTABLE LIGHT—Acetylene
Prest-O-Lite Co., Inc., 30 E. 42nd St., New York City.

POURING DEVICES
Arcade Mfg. Co., Dept. D, Freeport, Ill.
Modern Pouring Device Co., Port Washington, Wis.

POWER SQUEEZERS—See Squeezers—Hand and Power

PULLEYS—Magnetic
Magnetic Mfg. Co., 278 23rd Ave., Milwaukee, Wis.

PUMPS
Ingersoll-Rand Co., 11 Broadway, New York City.

PUMPS—Air Lift
Ingersoll-Rand Co., 11 Broadway, New York City.

PYROMETERS
Bacharach Industrial Instrument Co., 7000 Bennett St., Pittsburgh, Pa.

PYROMETER TUBES
Corundite Refractories, Inc., 920 Duquesne Way, Pittsburgh, Pa.

PYROSCOPES
Shore Instrument & Mfg. Co., Inc., Van Wyck Ave. and Carll St., Jamaica, L. I., New York.

RAILWAY EQUIPMENT—Cars, Industrial, etc.
Bethlehem Steel Co., Bethlehem, Pa.

RAMMERS—Sand Pneumatic—See Sand Rammers—Pneumatic

RECLAIMERS—Sand—See Sand Reclaimers

REFRACTORIES
Corundite Refractories, Inc., 920 Duquesne Way, Pittsburgh, Pa.

REFRACTORY—Special Shapes
Corundite Refractories, Inc., 920 Duquesne Way, Pittsburgh, Pa.

REGULATORS—Oxygen, Acetylene, Manifold
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

RIDDLES
Beardsley & Piper Co., 2541 N. Keeler Ave., Chicago, Ill.

RIDDLES—Reciprocating
Beardsley & Piper Co., 2541 N. Keeler Ave., Chicago, Ill.

RIVETERS—See Hammers—Chipping and Riveting—Pneumatic

RODS—Iron & Steel
Bethlehem Steel Co., Bethlehem, Pa.

RODS—Welding—See Welding Rods and Wire

ROLLER BEARINGS
Hyatt Roller Bearing Co., Harrison, N. J.

SAND
Industrial Silica Corp., Stambaugh Bldg., Youngstown, O.
Ottawa Silica Co., Ottawa, Ill.

SAND—Core
Great Lakes Foundry Sand Co., Penobscot Bldg., Detroit, Mich.
Industrial Silica Corp., Stambaugh Bldg., Youngstown, O.
Ottawa Silica Co., Ottawa, Ill.

SAND—Molding
Great Lakes Foundry Sand Co., Penobscot Bldg., Detroit, Mich.
Ottawa Silica Co., Ottawa, Ill.

SAND—Sandblast
American Foundry Equipment Co., 400 Byrkit Ave., Mishawaka, Ind.
Great Lakes Foundry Sand Co., Penobscot Bldg., Detroit, Mich.
Industrial Silica Corp., Stambaugh Bldg., Youngstown, O.
Menantico Sand & Gravel Co., Millville, N. J.
Ottawa Silica Co., Ottawa, Ill.

SAND—Silica
Great Lakes Foundry Sand Co., Penobscot Bldg., Detroit, Mich.
Ottawa Silica Co., Ottawa, Ill.

SAND—Silica Molding
Industrial Silica Corp., Stambaugh Bldg., Youngstown, O.

SAND—Steel Molding
Industrial Silica Corp., Stambaugh Bldg., Youngstown, O.
Ottawa Silica Co., Ottawa, Ill.

SANDBLAST ABRASIVES—Steel Shot and Grit
American Foundry Equipment Co., 400 Byrkit Ave., Mishawaka, Ind.
American Steel Abrasives Co., Galion, O.
Globe Steel Abrasive Co., Dept. F, Mansfield, O.
Sly, W. W., Mfg. Co., 4702 Train Ave., Cleveland, O.
Steelblast Abrasives Co., Cleveland, O.

SANDBLAST EQUIPMENT and Accessories
American Foundry Equipment Co., 400 Byrkit Ave., Mishawaka, Ind.
Arcade Mfg. Co., Dept. D, Freeport, Ill.
Direct Separator Co., Inc., Syracuse, N. Y.
Koven, L. O., & Brother, Inc., 154 Ogden Ave., Jersey City, N. J.
Mills Alloys, Inc., 3202 S. San Pedro St., Los Angeles, Cal.
Mott Sand Blast Mfg. Co., 4611 Flournoy St., Chicago, Ill.
New Haven Sand Blast Co., New Haven, Conn.
Parsons Engineering Co., 6536 Carnegie Ave., Cleveland, O.
Sly, W. W., Mfg. Co., The, 4702 Train Ave., Cleveland, O.

SANDBLAST NOZZLES—See Nozzles—Sandblast

SANDBLAST SHOT—Steel See Shot—Steel Sandblast

SANDBLAST TUMBLING Barrels—See Tumbling Barrels

SAND AERATORS
Beardsley & Piper Co., 2541 N. Keeler Ave., Chicago, Ill.

SAND CONTROL Machines
Dietert, Harry W., P. O. Box 1506, Detroit, Mich.

SAND CONVEYING AND Handling Equipment
Bartlett, C. O., & Snow Co., 6201 Harvard Ave., Cleveland, O.
Beardsley & Piper Co., 2541 N. Keeler Ave., Chicago, Ill.
Jeffrey Mfg. Co., The, Columbus, O.
Modern Pouring Device Co., Port Washington, Wis.
National Engineering Co., 549 W. Washington Blvd., Chicago, Ill.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.

SAND CUTTING MACHINES
American Foundry Equipment Co., 400 Byrkit Ave., Mishawaka, Ind.
Beardsley & Piper Co., 2541 N. Keeler Ave., Chicago, Ill.

SAND DRYERS
Bartlett, C. O., & Snow Co., 6201 Harvard Ave., Cleveland, O.

SAND GRINDING PANS—See Grinding Pans—Sand

SAND MIXERS AND Cutters
American Foundry Equipment Co., 400 Byrkit Ave., Mishawaka, Ind.
Bartlett, C. O., & Snow Co., 6201 Harvard Ave., Cleveland, O.
Beardsley & Piper Co., 2541 N. Keeler Ave., Chicago, Ill.
National Engineering Co., 549 W. Washington Blvd., Chicago, Ill.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.
Royer Foundry & Machine Co., Kingston Sta., Wilkes-Barre, Pa.

SAND MULLERS
Beardsley & Piper Co., 2541 N. Keeler Ave., Chicago, Ill.

SAND PREPARATION & Distributing Systems
Bartlett, C. O., & Snow Co., 6201 Harvard Ave., Cleveland, O.
Beardsley & Piper Co., 2541 N. Keeler Ave., Chicago, Ill.
National Engineering Co., 549 W. Washington Blvd., Chicago, Ill.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.

SAND RAMMERS—Pneumatic
Cleveland Pneumatic Tool Co., 3734 E. 78th St., Cleveland, O.
Ingersoll-Rand Co., 11 Broadway, New York City.

SAND RECLAIMERS
Bartlett, C. O., & Snow Co., 6201 Harvard Ave., Cleveland, O.
Beardsley & Piper Co., 2541 N. Keeler Ave., Chicago, Ill.
Jeffrey Mfg. Co., The, Columbus, O.
National Engineering Co., 549 W. Washington Blvd., Chicago, Ill.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.
Renewo Clay Products Co., 112 Elk Ave., Ridgeway, Pa.
Sly, W. W., Mfg. Co., 4702 Train Ave., Cleveland, O.

SAND SIFTERS AND Screening Machines
American Foundry Equipment Co., 400 Byrkit Ave., Mishawaka, Ind.
Arcade Mfg. Co., Dept. D, Freeport, Ill.
Bartlett, C. O., & Snow Co. 6201 Harvard Ave., Cleveland, O.
Beardsley & Piper Co., 2541 N. Keeler Ave., Chicago, Ill.
Diester Concentrator Co., Fort Wayne, Ind.
Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh.
Jeffrey Mfg. Co., The, Columbus, O.
National Engineering Co., 549 W. Washington Blvd., Chicago, Ill.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.
Royer Foundry & Machine Co., Kingston Sta., Wilkes-Barre, Pa.

SAND SLINGERS
Beardsley & Piper Co., 2541 N. Keeler Ave., Chicago, Ill.

SAND STORAGE BINS and Gates
Bartlett, C. O., & Snow Co., 6201 Harvard Ave., Cleveland, O.
Beardsley & Piper Co., 2541 N. Keeler Ave., Chicago, Ill.
National Engineering Co., 549 W. Washington Blvd., Chicago, Ill.

SANDERS—Portable
Bethlehem Steel Co., Bethlehem, Pa.

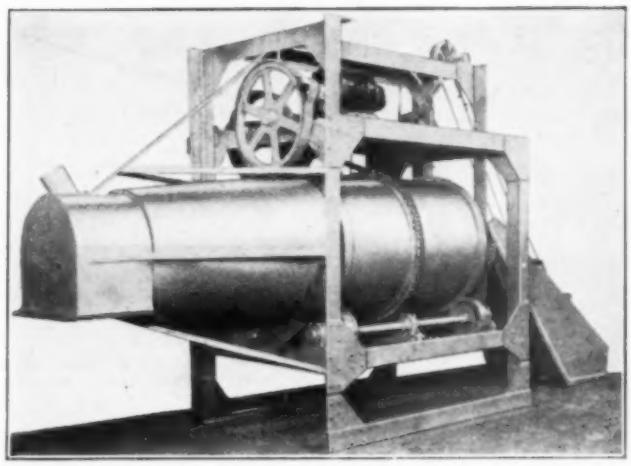
SAWS—Cold Metal
Tabor Mfg. Co., The, 6225 Tacony St., Philadelphia.

See Index to Advertisements for Pages Containing Advertisements of Companies Listed Above

Perfecting the Perfect Circle

"Perfect Circle" Piston Rings, made by the Perfect Circle Co., in their Newcastle, Indiana, plant, must be *right*. Quality standards are high—inspection is rigid.

These delicate castings are tumbled in an Ideal Star Return Barrel where they float in a charge of stars and steel shot. Reversal of the barrel discharges the load to a screen. Rings and tumbling material are separated, the rings emerging at the hooded end. Rotating the barrel again in tumbling direction automatically returns the tumbling material to the drum, ready to start work on the next batch. *No rehandling.*



Ideal Star Return Tumbling Barrel with hood.

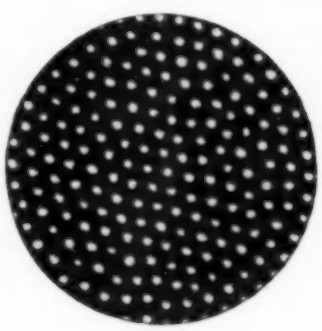
This system produces a finer finish than the tumbling process it displaced and *tumbling time is cut in half.*

Let us tumble some of your castings. Send us 25 lbs. and let us, without obligation to you, make a test run and send you a full report on the result.

Put it up to Specialists

N. Ransohoff Incorporated

West 71st Street at Millcreek, Carthage, Cincinnati, Ohio



SHOT
Clean—Well graded

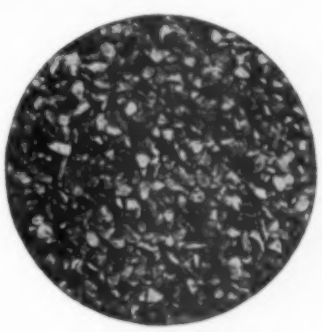
Chilled Steel

Mr. Foundryman:—

Now is your opportunity to save money on shot and grit for steelblasting. Samples and prices gladly mailed upon request.

Patch-Wegner Co., Inc.
Rutland, Vt.

Patch-Wegner Corp.
35 Boulevard, Long Island City, N. Y.



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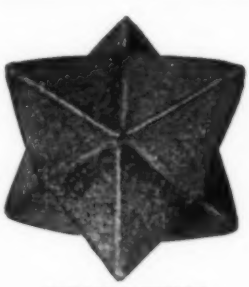

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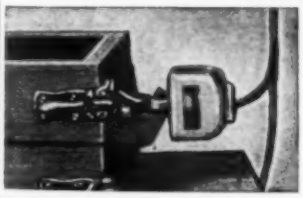

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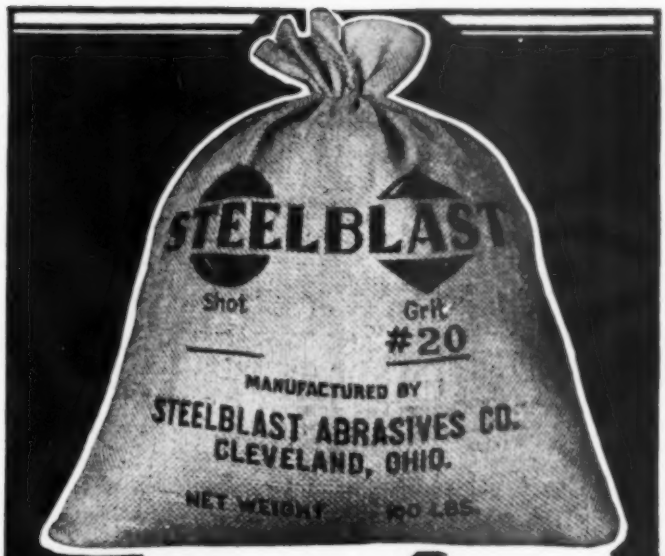

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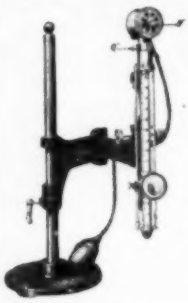

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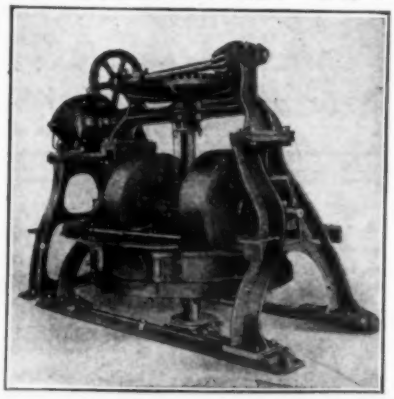

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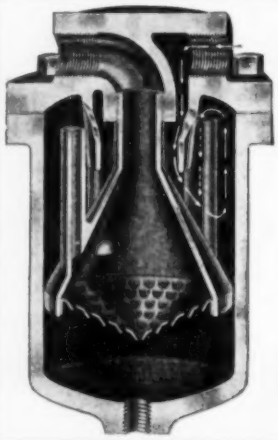

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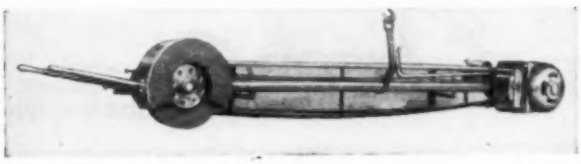

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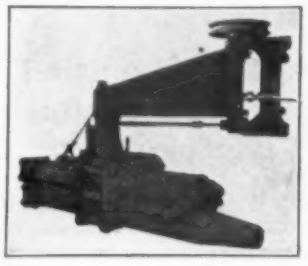

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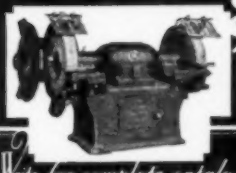

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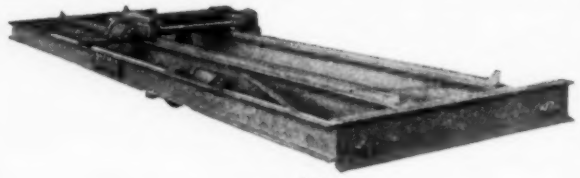

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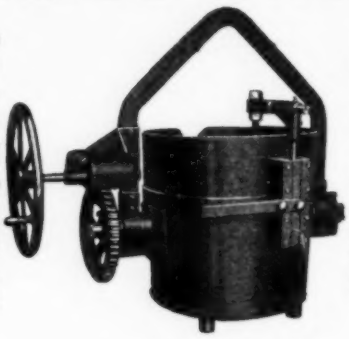

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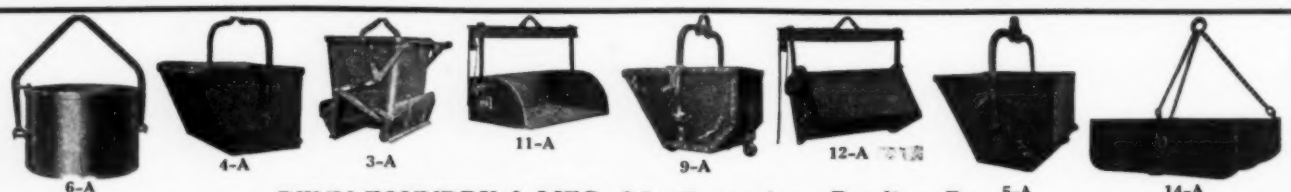

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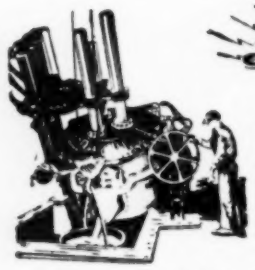

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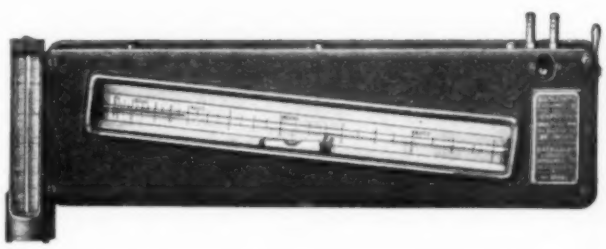

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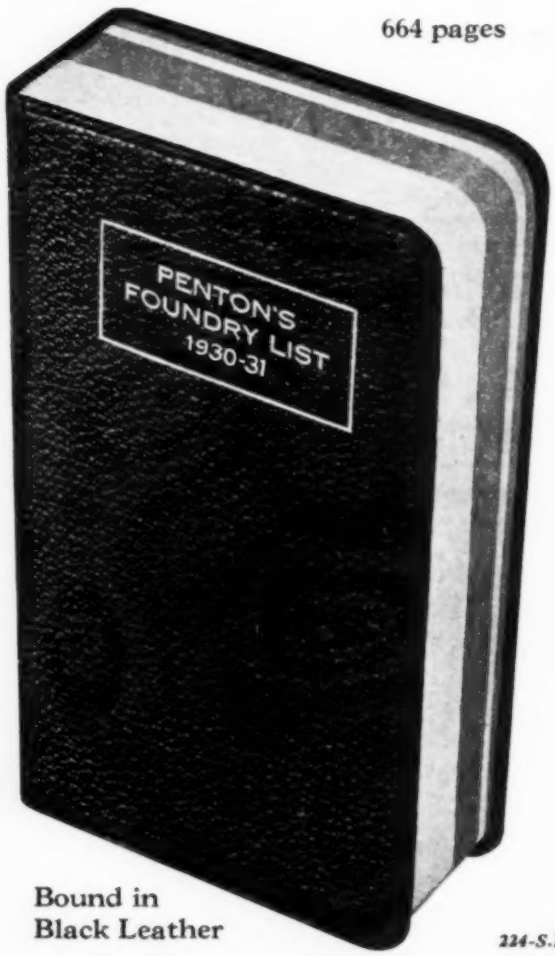

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224-S.F.D.

Classified Ads

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Experienced cleaning room foreman for 200 molder foundry in Middle West. Light and medium weight castings. Must be thoroughly familiar with latest grinding, tumbling and sand blast practice, and set piece-work prices, to get work through quickly and efficiently. State age, past experience and salary expected. Address Box 704, THE FOUNDRY, Cleveland.

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to sell Fluxes to Brass, Aluminum and Gray Iron Foundries, also Smelting Plants. Must be a practical foundryman who understands what fluxes are used for and how they should be used, and be able to make demonstrations. Our line consists of brass flux for crucible furnaces; refining flux for removing aluminum from brass; gray iron ladle flux; aluminum flux; refining flux for nickel alloys; refining flux for removing iron from brass; smelting flux for crucible furnaces and smelting flux for open flame furnaces. Territory United States and Canada. State your age, references and what selling experience you have had, if any. Address Box 711, THE FOUNDRY, Cleveland.

IF YOU ARE OPEN TO OVERTURES FOR new connection, and qualified for a salary between $2500 and $25,000, your response to this announcement is invited. The undersigned provides thoroughly organized service of recognized standing and reputation, through which preliminaries are negotiated confidentially for positions of the calibre indicated. The procedure is individualized to each client's personal requirements; your identity covered and present position protected. Established twenty-one years. Send only name and address for details. R. W. Bixby, Inc., 101 Downtown Building, Buffalo, New York.

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Address Box 688

THE FOUNDRY

Cleveland

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An old established concern in the East desires to engage the services of a foundry foreman for their gray iron foundry. Salary to start, $200.00 per month. Will only be interested in a man who can produce a high quality of work. In answering, state age, names of former employers and references. Address Box 705, THE FOUNDRY, Cleveland.

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8" "	50.00	45.00	40.00	35.00
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15" (½ page)	90.00	80.00	70.00	60.00
30" (1 page)	160.00	140.00	120.00	100.00

Count 10 lines to the inch for actual type matter and allow accordingly when white space is desired.

THE FOUNDRY is published on the 1st and 15th of each month. Copy for the classified section should reach us twelve days before date of issue.

Help Wanted

MR. FOUNDRYMAN

If you are anxious to locate a position, get in touch with the executives of the largest foundries throughout the world through the classified section of THE FOUNDRY.

Just write us giving your past experience, the position you want and any information which will be of interest to prospective employers. Also tell us the number of words that you would like to use in your ad. The cost is 5 cents per word, minimum ad 1.50 per issue.

Address your letter to the Classified Advertising Department, THE FOUNDRY, Cleveland. We will do all we can to make up an advertisement that will draw results.

Positions Wanted

FOUNDRY ENGINEER

Technical training. Experienced in the design and layout of modern gray iron production foundries and sand condition, mold conveying and casting handling equipment. Experienced in report writing involving production studies, combination of two or more manufacturing plants, cupola control, laboratory testing. Now employed by a large engineering firm on foreign work which is nearing completion. Desire a free lance position in a moderately sized plant which needs revamping. Address Box 703, THE FOUNDRY, Cleveland.

GENERAL MANAGER AVAILABLE

A man with 25 years experience in the operation of gray iron and malleable foundries is desirous of changing his present connection. His experience covers all phases of foundry operation. He is well grounded in coremaking, sand control and metal mixtures. His past record proves him thoroughly able to manage a large establishment. Foundry costs, plant organization, machine shop operation and sales problems are well within his confines. Address Box 710, THE FOUNDRY, 1347 Peoples Gas Bldg., Chicago, Ill.

Positions Wanted

WANTED

Position as Malleable Foundry Foreman. At present employed, but desires a change. Can handle all classes of work and rig for best production. Best references. Address Box 714, THE FOUNDRY, Cleveland.

STEEL FOUNDRYMAN

Thoroughly conversant with up-to-date and modern foundry conditions. Efficient rigger for machine production, sand mixing, gating, heading and regulating shop costs. Address Box 715, THE FOUNDRY, Cleveland.

BRASS FOUNDRYMAN

past 20 years employed as superintendent, desires position as Superintendent or Foreman in brass, bronze and aluminum foundry. Experience covers general jobbing and production work on high pressure castings. Good references. Address Box 707, THE FOUNDRY, Cleveland.

FOUNDRY ENGINEERS

Two technical graduates desire connection. Chemists, mixing by analysis, alloying, production and time study, machine shop practice, sand control, metallography and research. Past four years connected with leading companies and technical institutions. Desire connection with future and opportunity to produce results. Address Box 700, THE FOUNDRY, Cleveland.

FOUNDRY SUPERINTENDENT

Gray iron or steel foundry superintendent desires permanent connection. 20 years practical experience on heavy and light work. Technical education. Well versed in foundry management. Melt by analysis. McLain graduate. Address Box 697, THE FOUNDRY, Cleveland.

SUPERINTENDENT

Foundryman thoroughly experienced on all classes of gray iron and brass foundry work desires permanent connection as foundry superintendent. Will accept a moderate salary and percentage on savings. Address Box 647, THE FOUNDRY, Cleveland.

POSITION WANTED

Electric furnace superintendent experienced on all makes of electric furnaces making alloy and carbon steels. Capable of maintaining equipment. Address Box 712, THE FOUNDRY, Cleveland.

FOUNDRY SUPERINTENDENT

15 years executive and technical experience. Practical mechanic; light and heavy work; handle blue prints; mix iron by analysis. Good cupola supervision. Capable of building, rigging and maintaining efficient organization. References. Moderate salary. Address Box 717, THE FOUNDRY, Cleveland.

FOUNDRY FOREMAN

with 18 years experience in open hearth and electric steel foundries desires position as foreman or assistant foreman. Well versed in heading, gating, and rigging for machine production. Address Box 706, THE FOUNDRY, Cleveland.

POSITION WANTED

Superintendent and metallurgist of electric steel foundry desires to make change. 17 years of foundry and furnace experience in making alloy and carbon steel. Address Box 713, THE FOUNDRY, Cleveland.

METALLURGIST AVAILABLE

Eight years active charge melting, laboratory, foundry control and investigation; floor and continuous operations on cored, light metal line gray iron castings, pressure tested. To 300 tons daily. Qualified references. Married, age 33. Address Box 718, THE FOUNDRY, Cleveland.

Classified Ads

Positions Wanted

CUPOLA EXPERT

22 years practical and technical experience in cupola work. Can operate and take full charge of any gray iron or semisteel cupola and produce the best results. Address Box 699, THE FOUNDRY, Cleveland.

MASTER MECHANIC

15 years gray iron, malleable and steel foundry experience covering machine molding, conveyor, electric and steam work. Address Box 702, THE FOUNDRY, Cleveland.

EXPERIENCED FOUNDRYMAN IS DESIROUS of securing a connection as sales representative for molding machine manufacturer or a manufacturer of foundry equipment. Several years sales experience. Address Box 658, THE FOUNDRY, Cleveland.

SUPERINTENDENT

Iron foundry superintendent desires position. Pacific Coast preferred. Past 13 years in tractor and harvester work. Previously automobile work. Expert on pattern layout, molding, coremaking and cupola practice. Mix by analysis and know how and when to use steel or alloys. Former employers have closed Pacific Coast plant. Best of references. Address Post Office Box 561, Stockton, Calif.

FOUNDRY MANAGER

Experienced, practical, thorough. Salary and percentage of savings or bonus, with option to invest. Negotiations by personal interview only. Address Box 673, THE FOUNDRY, Cleveland.

GRAY IRON FOUNDRYMAN

thoroughly experienced and practical middle-aged molder, melter and coremaker desires position. 12 years in charge of foundries. Experienced heavy and light jobbing and production work, also soil pipe and fittings. Good organizer and rigger. Ambitious and inventive. Best of reference. Address Box 656, THE FOUNDRY, Cleveland.

BRASS AND BRONZE FOUNDRYMAN

A practical brass and bronze foundry foreman desires position. Experienced on ornamental bronze, chandelier castings, jobbing and production work. Age 38. Address Box 684, THE FOUNDRY, Cleveland.

ATTENTION FOUNDRY OWNERS!

Write or wire us for technically-trained practical foundry foremen, superintendents, production managers, chemists, metallurgists, core foremen, cost clerks, salesmen, patternmakers, melters (electric, open-hearth, converter and cupola). No charge. McLAIN'S SYSTEM, INC., 804 Goldsmith Bldg., Milwaukee, Wis.

POSITION WANTED

If you are looking for a man with unquestionable ability and experience in the malleable iron business, write for interview and reference. At present employed. Address Box 690, THE FOUNDRY, Cleveland.

POSITION WANTED

as General Superintendent in stove, furnace or light job casting foundry. Exceptional knowledge of furnaces and gas goods. Can furnish best of references. Address Box 677, THE FOUNDRY, Cleveland.

POSITION WANTED

as Foundry Foreman or Superintendent by an experienced and able man of middle age, especially qualified to make light and medium weight castings. Can furnish good references. Address Box 668, THE FOUNDRY, Cleveland.

Positions Wanted

FOUNDRY SUPERINTENDENT

or Manager. Vigorous middle-aged man with world of experience on heavy and light work, iron, steel and brass, sand and loam. Heavy work shop preferred. Employed but seeks new connection in January. Splendid references. Strictly confidential. Address Box 646, THE FOUNDRY, Cleveland.

MALLEABLE FOUNDRY FOREMAN

desires new connection. Age 33 and a hustler. Know how to rig jobs for real production. Familiar with mold conveyors, sand control, etc. Will go after your molding loss intelligently and produce results. Estimate piece work prices from blue prints, etc. Address Box 657, THE FOUNDRY, Cleveland.

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ARE YOU
LOOKING AHEAD?

You want the best men available for every department of your plant.

And if you do not pick experienced men now, it may be impossible to suitably fill your vacancies later.

Do you realize that just such men are watching this section waiting to go after the opportunity you have to offer?

Your use of the Help Wanted columns will convince you that real wide-awake men are interested now—and when you receive your replies, be kind enough to answer all of them, if only to return the letter stating that the position has been filled.

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with long time and varied experience in foundries, open for position. Address Box 637, THE FOUNDRY, Cleveland.

METALLURGIST

available on short notice. Young married man with seven years experience in steel work as metallurgist, assistant superintendent in charge of melting, heat treating, analysis, sand testing and control, also research and consulting work. Excellent references. Address Box 660, THE FOUNDRY, Cleveland.

GRAY IRON FOUNDRY SUPERINTENDENT or foreman wishes to make a change. Experience with sandslinger, jolt and hand production and jobbing molding and rigging for same. Capable of maintaining an efficient organization. Experienced in sand control. Mix by analysis. McLain graduate. 25 years experience. Salary reasonable. Address Box 669, THE FOUNDRY, Cleveland.

GRAY IRON FOUNDRY SUPERINTENDENT OR FOREMAN, OPEN FOR ENGAGEMENT. BROAD EXPERIENCE IN SMALL AND MEDIUM HEAVY GRAY IRON AND SEMI-STEEL CASTINGS. THOROUGH KNOWLEDGE IN RIGGING AND MOLDING MACHINE PATTERN EQUIPMENT FOR MASS PRODUCTION. AGGRESSIVE LEADERSHIP FOR EFFICIENT ORGANIZATION. MIX BY ANALYSIS. ADDRESS BOX 671, THE FOUNDRY, CLEVELAND.

FOUNDRY SUPERINTENDENT

seeks new connection, at present employed. Technical, capable, with proven ability. A hustler, up to date on cupola practice and mixing of high test cast iron. Have studied the foundry in all its phases. Good rigger on jobbing and production. Am not a bluffer. Address Box 692, THE FOUNDRY, Cleveland.

Positions Wanted

Foundry foreman with specialized experience in Stainless Steel castings, and preference for the East. Address Box 708, THE FOUNDRY, Cleveland.

GRAY IRON FOREMAN

or assistant. 20 years experience, high pressure boiler and tank heater castings, also jobbing work. Can get good production by molding machine or hand work. References. Available immediately. Address Box 698, THE FOUNDRY, Cleveland.

WANTED

Position as General or Foundry Superintendent by man with thirty years practical experience from coreroom to plant manager, on boilers, radiators and general jobbing work. Mix by analysis and accustomed to conveyor lines and all classes of machines. Will go anywhere. Address Box 683, THE FOUNDRY, Cleveland.

FOUNDRY FOREMAN

open for a position. 20 years experience in green, dry sand and loam work. Not a school graduate but one who knows the business. Address Box 696, THE FOUNDRY, Cleveland.

Opportunities

OPPORTUNITY

Engineering firm in England wants sole manufacturing and selling rights for really good engineering product on royalty basis. Must be of very distinct merit and wide application. Box L14, c/o W. H. Smith & Son, Ltd., Blackfriars, Manchester, Eng.

AN OPPORTUNITY
to step into an
ESTABLISHED BUSINESS

$25,000—will secure controlling interest in a concern that is manufacturing and marketing a material and process, by which use, loose patterns and gates are placed on production basis in the foundry, doubling its output with the same payroll. For two years in use in leading foundries. No competition. Aged owner needs relief. All replies confidential. Give complete details to be considered.

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THE FOUNDRY
Cleveland.

FOUNDRY ENGINEERING
INSTRUCTIONS

50 cents each lesson

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THE FOUNDRY
Cleveland

WANTED

Partner with $30,000.00 to buy half interest and become actively identified with iron foundry, manufacturing municipal castings. New and economical method of making lamp posts. Machine shop, pattern shop, and brass foundry. Location, Eastern Pennsylvania. Gilt-edged contracts on hand. This business can be purchased outright for a cash consideration slightly more than $30,000.00. Address Box 701, THE FOUNDRY, Cleveland.

Classified Ads

For Sale

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(1) Battery Central square, exhaust type mills, 25" and 36" x 40" long.
(1) Battery Central round, exhaust type mills, 36" diam. x 54" long.
(1) Type A, 36" x 46" New Haven Sandblast Barrel.
(1) Type G. D. No. 1, 24" x 30", Pangborn Sandblast Barrel.
(1) new Pangborn Sandblast Cabinet type E.N. —2 No. 53, 36" x 36" x 60" with 6" x 6' Duplex Curtis Compressor, tank, belt, motor, all accessories.

Send for our latest list of "Rebuilt Guaranteed Equipment."

T. B. MacCABE
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FOR SALE

18 x 8, type M, International Molding Machine. One 1000-lb. Ruemelin Sand Blast Machine. One Arcade Jolt Squeeze Molding Machine, 12 x 18. These machines in use six months.

The Stearman Aircraft Company
Wichita, Kansas.

FOR SALE

Sand Cutter—Manufactured by American Foundry Equipment Company, Size 50 No. AA-552. Good condition. Replaced by Sand Handling Equipment. Price, $350.00.

The Hill Clutch Machine & Foundry Co.
6400 Breakwater Ave.
Cleveland, Ohio.

FOR SALE

One Connellsville Positive Pressure Horizontal Top discharge Blower, capacity 24 cu. ft. per revolution. Blower is mounted upon bedplates and equipped with gears for motor drive.

Address Box 709,
THE FOUNDRY. Cleveland.

For Sale

MOLDING MACHINES

1 Herman 40 x 56" Independent Turn-Over and Pattern Drawing Device, 40 x 50" Bumper.
1 Osborn No. 404 Jolt roll-over pattern draw, flask capacity 40 x 54", pattern draw 15", lifting cap. 1500 lbs. @ 80 pounds pressure with run-out Mould Car.
1 Osborn No. 403 Jolt roll-over pattern draw, flask capacity 44 x 36", pattern draw 12", lifting capacity 1400 lbs. @ 80 lbs. pressure with swing-out Mould Table.
1 Osborn No. 402 roll-over Jolt, flask capacity 36 x 15"—lifting cap. 750 lbs. @ 80 lbs. pressure.
1 International Type G, stationary, combination jar ramming, power turn-over, foot draw for flasks up to 24"—10" pattern draw.
1 Osborn No. 549 Jolt Stripper, jolt cylinder dia. 6", jolting capacity 950 lbs.

SQUEEZERS

2 Osborn No. 74, 8½" cylinder, 30" between rods, 14 x 18" table.
3 Osborn No. 75, 10" cylinder, 36" between rods, 16 x 20" table.
2 Rapid Plain Squeezers, portable, bench plate 21 x 14"—vertical adjustment 15".

MISCELLANEOUS

Pangborn Steel Sand Blast Room 7'6" x 10' x 7'6" including Sand Elevating Device, Overmounted Steel Dust Arrester and Hose Type Sand Blast Tank.
1 Middleditch Power Sprue Cutter, 9" depth of throat, ¾ x 1½" capacity, single pulley.
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1 Worthington Duplex Feather Valve Compressor, 15 x 9½ x 12, 650 cu. ft. displacement, complete with Lubricator and unloader.

Our List contains complete stock on hand.

SCULLY-JONES & COMPANY
19th & Rockwell Sts., Chicago, Ill.

For Sale

FOR SALE

12 x 10 Ingersoll Rand Air Compressor with 60 H. P. Slippering A. C. Motor.
50" Sly Sand Blast Barrel.
Number 34 Davenport Jolt Roll-over Machine.
A lot of ladle Bowls from 400 pounds to 600 pounds, NEW.

JOHN MERTES
196 East Water St.
Milwaukee, Wis.

CUPOLA BLOWERS FOR SALE

1—No. 3 Root Blower
1—No. 5½ Root Blower

Good as new. A bargain

DAVIS FOUNDRY & MACHINE WORKS
Rome, Georgia.

Wanted

WANTED

Something to manufacture in our machine shop and sell to the foundry trade. The Federal Foundry Supply Co., Station D, Cleveland, O.

WANTED

50 x 75 flasks—22" x 28", — 7" cope and 7" drag. Must be in good condition. Address Box 716, THE FOUNDRY, Cleveland.

Note What One of Our Readers Has to Say—

Following is an excerpt from a letter which is characteristic of many we have received at various times:

"and I wish to advise you that I have accepted a position, which by the way, came to me through an advertisement in THE FOUNDRY"

The Classified Section of THE FOUNDRY has been proven to be a very valuable aid to the many needs of foundrymen and it can be of vital assistance to you in obtaining a position—or in the daily needs of your business. One of the following departments might be of use to you—

Help Wanted	*Opportunities*
Positions Wanted	*Foundries For Sale*
For Sale	*Wanted*

Just jot down your advertisement on a slip of paper—fill in and clip the handy coupon attached—and send them both to us, with your remittance. You will find rates on the first page of this section.

The Foundry
Cleveland, Ohio

Please insert the attached advertisement in the.....column of..... issues of THE FOUNDRY, for which I enclose $.....

Name.....

Address.....

.....

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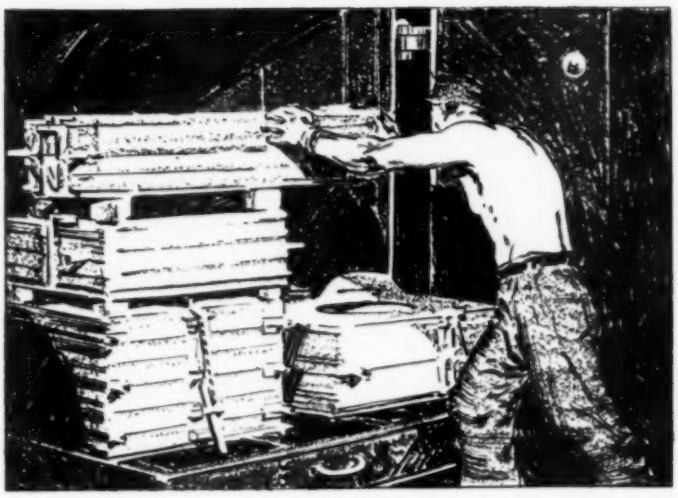

THE 1931 BUYER WILL DEMAND BETTER CASTINGS

THE castings buyer has been an interested spectator as progressive foundries have contested for his business. This buyer is quick to see the advantage to him of improved melting practice, closer metallurgical control and increased casting uniformity through better molding procedure. He has grown to expect better castings.

One of the requisites of better castings is the proper baking of both cores and molds—cores and molds which are baked evenly and which hold dimensions accurately—in which all the core binder is fully oxidized without being burnt—cores which will not crush or wash but which will clear readily in the shake-out.

A good foundry oven will not only keep the quality of your cores and molds consistently high but will also effect substantial savings in both fuel and labor.

In planning 1931 operations make sure your Core Department is able to keep pace with the inevitable demands of 1931 buyers. You incur no obligation in asking for a conference with one of Young Brothers Engineers.

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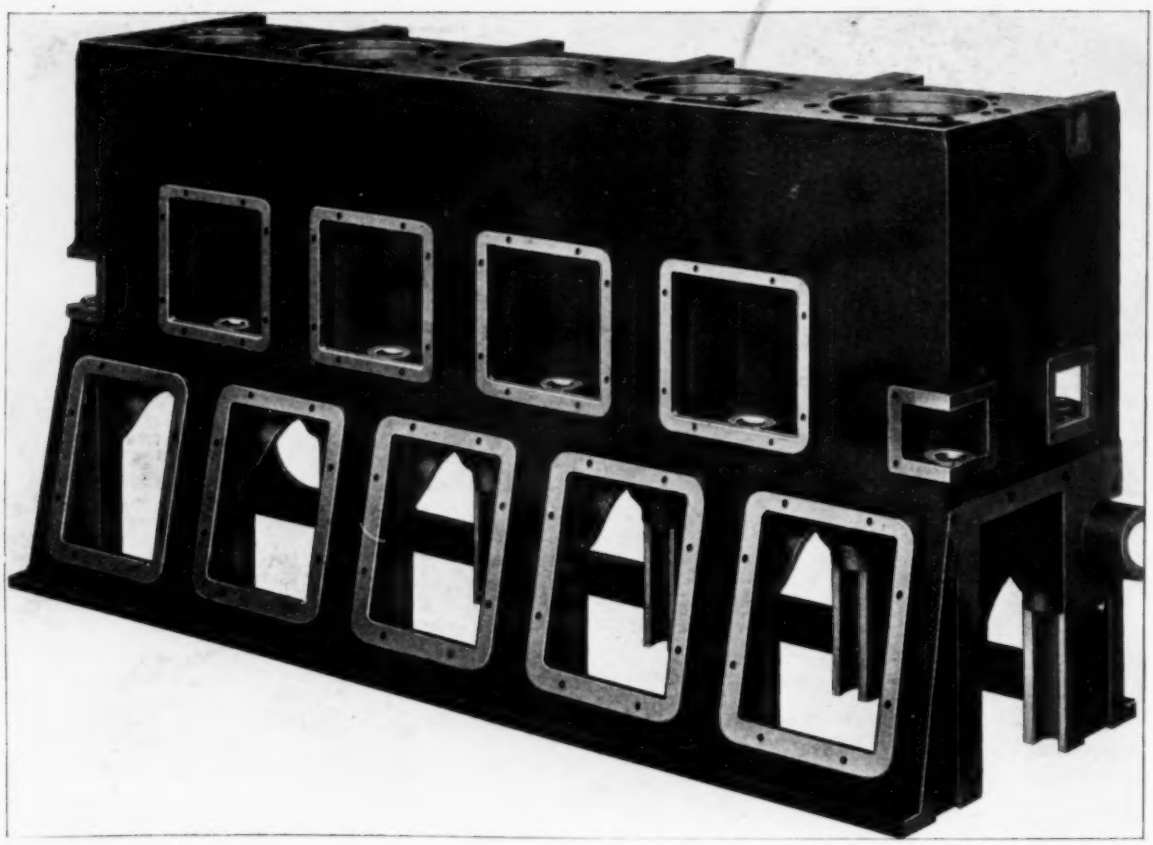

Cylinder Block for Marine-Type Diesel Engine, made with Mayari in the mixture.

Mayari
in power plant equipment

Castings for use in Diesel engines and other power plant equipment must be thoroughly dependable. Such castings must possess great strength. They must be tough, non-porous and free from segregation; they must offer considerable resistance to abrasion, and possess a structure of uniform density throughout sections of varying dimensions.

Mayari, a natural nickel-chromium alloy pig iron, is extensively used for making castings for this service. Mayari imparts increased strength and solidity, smoother surfaces and closer-grained structure, eliminates spongy spots and segregation, improves machining qualities, and results in increased resistance to heat and wear.

Mayari brings you superior castings at an almost negligible increase in cost, and improves foundry operations, as well, due to the lower freezing point of the molten metal, its greater fluidity, and longer life in the ladle.

Write the nearest District Office for additional information on Mayari. Bethlehem foundry specialists will be glad to explain the many advantages derived from the use of Mayari, and to discuss its application to the castings you make or use.

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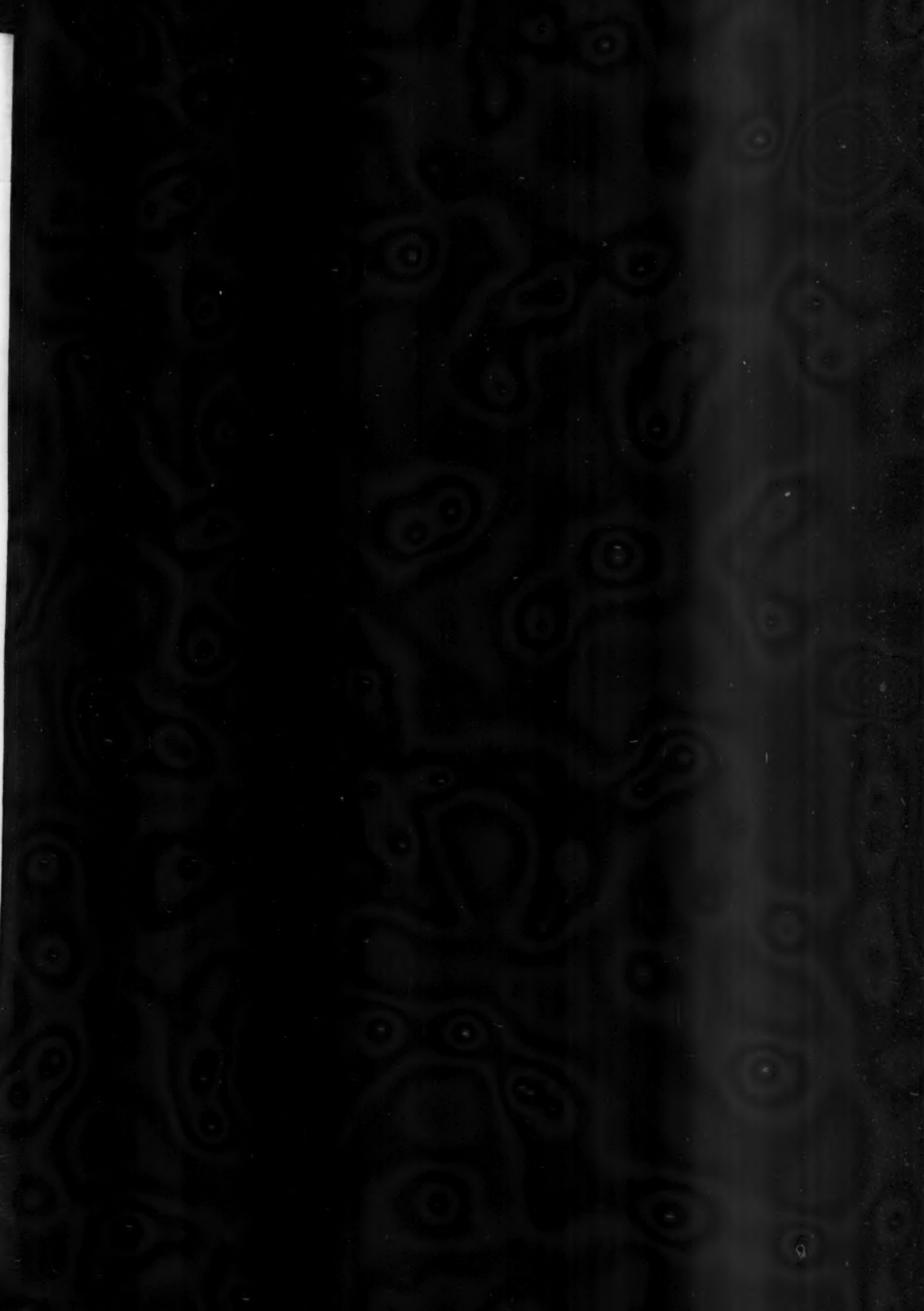
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